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The WIRELESS AGE

"America's Foremost Radiophone Review"

October
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Carries Great Messages Around the World

THAT statement adequately expresses what is perhaps the greatest influence of radio in developing and bettering human fraternal interest, not only between the people of one community, of one country, of one state, or even a single nation, but between all nations and all peoples of the world.

Be these messages from government leaders—from the heads of the world's greatest educational institutions or from those who stand foremost in the arts of the world—they will serve to bring the human race into closer contact.

In the past ages great orators and writers, famous poets and musicians have swayed the destinies of nations, and have been instrumental in the rise and downfall of mighty empires.

In the future these same influences of similar great minds will, through radio, create a better understanding and a greater fraternal spirit between the people of the nations.

It is the vacuum tube that has made possible this broad and far reaching application of radio telephony, and that plays the most important part in the operation of your receiving set.

Cunningham Vacuum Tubes, standard for all makes of receiving sets—built by one of the world's largest manufacturers with unlimited resources—are the product of years of manufacturing experience and the creative genius of the engineers of that great scientific organization, the Research Laboratory of the General Electric Company.

Cunningham Radio Tubes

C-301A—6 Volts ¼ amp. Amplifier	$6.50
C-299—3 Volts .06 amp. Dry Battery Det. & Amp.	6.50
C-300—6 Volts Gas Content Detector	5.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base	6.50
C-12—Similar to C-11 with standard base	6.50

Patent Notice: *Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.*

E. T. Cunningham Inc.

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September 24 to October 1, 1923

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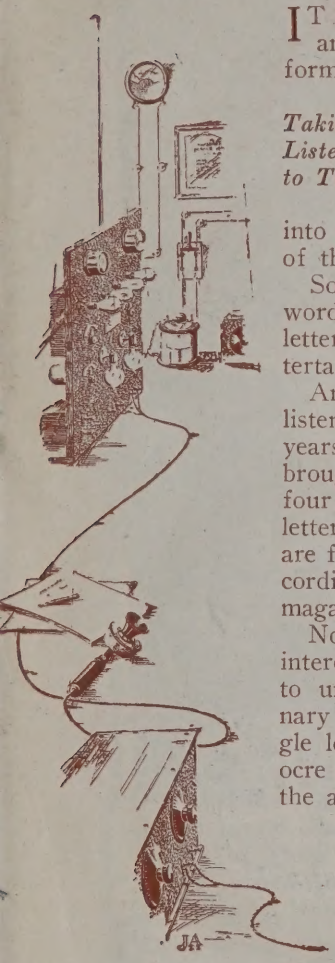
In Our Opinion



Taking the Listener to Task

IT is not nice to scold. Particularly in an editorial, which is a constructive form of writing. But the function of this page of opinion is to make readers thoughtful about the happenings in radio. And sometimes the public has to be jolted into realization of its place in the scheme of things.

So it has become a duty to say a few words about the woeful slump in writing letters of appreciation to those who entertain through the ether.

An amazingly small percentage of the listeners are writing, these days. Two years ago, an impressive program brought a response from one person in four; today, right now, the ratio is one letter for every 20,000 listeners. These are facts, ascertained through careful recording and study by the staff of this magazine.

Now these figures apply to specially interesting programs. It is not difficult to understand, therefore, that an ordinary performer would not receive a single letter. Many who are not of mediocre calibre, however, hear nothing from the audience; and this lack of appreciation of real talent is discouraging.

Those who have not faced the microphone can never understand the difficulties of doing oneself justice; the unresponsive disc is very disconcerting to the ablest and most experienced entertainers. They conclude their performance with the uncomfortable feeling that they have tried their utmost, but have not given their best. Which is because there are no human faces before them to express approval or disapproval, no sound to register approbation or lethargy. It is as inspiring as talking to yourself in a dark closet.

But the station manager assures the performer that hundreds of thousands of persons are listening; they will write, and the "applause" will be very gratifying. And then . . . silence. Or a stray letter or two.

The artist has spoken, or played or sung into a metal disc with the stimulating thought or vision of a vast audience, some of whom will be indifferent, but there will be others who will really enjoy the entertainment. But the reward is expression in infinitesimal proportions, or no expression whatever. The sensation is comparable only to playing in a theatre filled with people with masked faces and forbidden to applaud or even make a sound.

It can't go on. No artist can be expected to continue broadcasting without the stimulus of appreciation. Even censure would be better than silence.

The difficulties of letter-writing in adequate proportions are obvious, for there are too many stations broadcasting and a multiplicity of performers and programs. In an evening, a half-dozen stations may be listened to, for a few minutes each. Some give enjoyment, some do not. But where there is enjoyment, certainly a note of thanks has been earned. The entertainment is free, so the few minutes required to jot down an appreciative phrase or two is not much to expect of the listener.

If it isn't done—this is fair warning—the most talented performers will quit. Several have said so, plainly. And it happens that those who have served notice are the biggest radio stars of all!

That is why this editorial was written.

The situation is serious. Continued carelessness will cost the public dearly.

* * *

Reaching the Saturation Point

PROBABLY the peak has been reached in the installation of broadcasting transmitters. Not a single application for a license was made in the first week of September, and four stations discontinued. More than 500 stations remain, however, and as every listener knows, this number is about ten times more than is required to cover the whole United States. For the past eighteen months, persons and firms in every conceivable business have been falling over themselves to get their individual ideas on the air. But delivering broadcast service is an expensive proposition and it is certain that many will discontinue and others who contemplated entering the field will hesitate about taking on the requisite heavy financial obligations. Gradually, the field will clear up, and it appears that the day is not far distant when the owner of a tube set will be able to "hold" a particular station throughout its program without the annoyance of overlapping carrier waves.

Which, of course, will give stability to broadcasting; for, after all, the unskilled outnumber the scientific hobby converts, and radio's real function is to deliver an entertaining program with fidelity to the arts represented.

* * *

The Savior of Humanity

WHILE Japan's cry for help is still ringing throughout the world, a thought should be given to the marvel of radio as an unfailing aid to humanity. Once more the invisible electromagnetic waves have done the job when all other means of communication were rendered inarticulate.

Cities and villages crumbled, buildings burst into flame and homes toppled into rising waters when the great earthquake brought disaster to the Island Empire; a hundred thousand persons died and millions faced death from hunger, disease and exposure. The tragedy of it all would have wrung the heart of the world had it been that weeks elapsed before sister nations heard the call for succor. The awful consequences of delay sicken the imagination. But radio came through. The frenzied appeal was heard across the ocean, and the greater catastrophe was averted.

The tradition still lives: The operator faithful at his post and the electrical impulses dedicated from birth to the mission of life-saving unfalteringly obeying his command.

Man's greatest gift to humanity—that is radio.

—THE EDITOR.

148078

Fans Are Here, There and Everywhere

Manipulating levers equally well to jazz or stately measures is the achievement of Edward Joackin, yard signalman on New York's elevated railway

In a primitive camp along the Mohawk River, near Schenectady, radio brings the outside world to Dr. C. P. Steinmetz, the electrical wizard

From their facial expressions this group of Indians can hardly be classified as radio enthusiasts, but it is their first experience and strains of syncopation from the loud speaker may yet modernize the night dances at Wind River Reservation, Wyoming

It May Be Construction—or Contest

Mitzi, famous musical comedy star, wields a potent screwdriver in support of the claim that she made this five-tube receiver

Monkeying with the radio is a familiar pastime even to Ritzy, whose training embraces impersonations of all activities of up-to-date humans

All square and four to play is the situation in this game of radio golf, the winner of which—his back is turned here—logged his eighteen stations in less than an hour

Indoors and Out, They Listen

Cornelius Vanderbilt, Jr., and his bride occupy chairs outdoors in a Los Angeles garden when enjoying the broadcast concerts from Pacific Coast radio stations

More insulation than antenna spread makes this mobile receiver a typical small boy installation and evidently calls for some concentration from Johnny Jones, the juvenile film star

Jean Tolley's boudoir bandeau of orchid and purple velvet is in reality a headphone set which at once serves the ear and pleases the eye

The gipsy caravan has adopted an accessory to modern civilization and broadcasting entertains the roving radioists, although Romany Rye and his family still cling to the customs of their ancestors

Although his business is pictures, Marcus Loew hasn't been photographed in many years—that is, until he broadcast at the opening of Station WHN on top of one of his New York theatres

This Diversity Is Radio's Charm

Col. King Stanley faces WOR's microphone when making his marriage vows to Grace A. Raymond, the bride

Jack Dempsey, whose fistic achievements have been heralded through space on two exciting occasions, tries out his voice at N. Y. Police Games

Radio rehearsing in the Venetian Garden of Miss Fowler's Long Island estate plays its part in the perfection of the swaying grace of Addison and Fowler, widely known to the American public as whirlwind dancers, who are giving the Valentinos a close run for fame and fortune

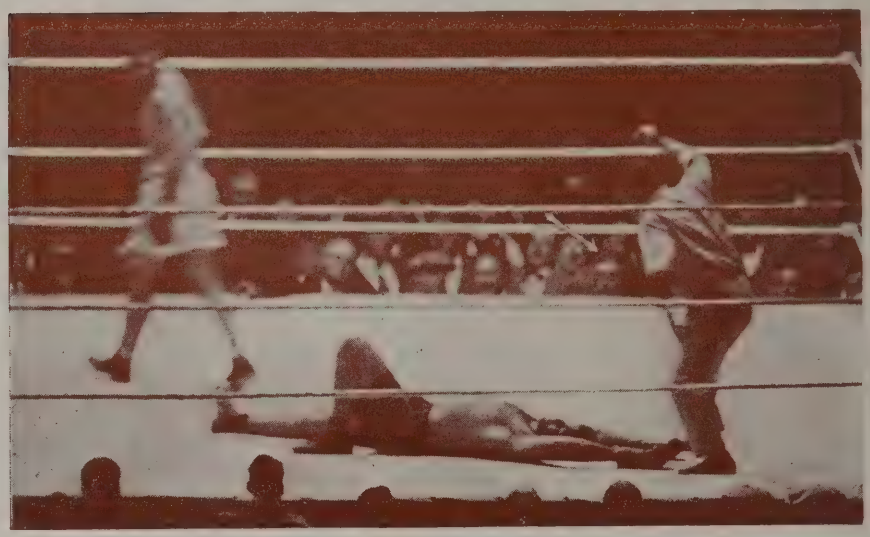
Big Bill Edwards, onetime football star and former Collector of Internal Revenue, is worshipfully watched by four honor Boy Scouts as he broadcasts the organization's activities

The Thrill That Left

When Dempsey Went Through the Ropes And Came Back to Knock Out Firpo the Greatest Radio Audience "Saw" It All

By Capt. Robert

J. Andrew White, Editor of "The Wireless Age" in action. To the right, at the ringside (see arrow); and above, close-up as he gave his listeners moments dramatic, humorous, personal, appealing and exciting



"SIX - seven - eight - nine - TEN! Firpo's out!"

The voice whose message was heard half way around the world and which brought despair to all Argentina, fairly shrieked the closing words of another memorable broadcast from the ringside at the Polo Grounds.

Everyone knows, of course, what happened—how Jack Dempsey, the world's premier heavy-weight title holder, met Luis Firpo, pride of the South American continent, and when it was all over our representative still held the championship.

Prize fighting never before has been so glorified—so dignified—radio has removed the stigma of other days, when it was not "good form" in polite society to be numbered among those so reduced to the level of the beast as to desire to witness a bout. In little more than two years radio has changed all this.

When the first championship fight was broadcast, in July, 1921, there were some misgivings. But the way it was done put it over. Then there were lesser fights, several in rather close succession, and immediately the radio public approved. Probably a large percentage of the listeners to the description of jabs and feints and counters and swings could not have been persuaded to go to the ringside. But in the privacy of their homes they could listen, and the thrill was as great, the combat as good—if not better in some respects—than actually seeing it.

The primeval instinct revived as J. Andrew White skilfully told each move, with a running fire of comment which made the scene vivid; the prize fight became a boxing contest, and as such was countenanced.

So it was that not only were there distinguished citizens among the 85,000 spectators at the Polo Grounds for the Dempsey-Firpo bout, but there were millions who sat with receivers clamped to their ears, or who faced the loud speaker and cheered themselves hoarse as the stirring details came in. Many of the clerical profession and others to whom fights are not exactly the thing, could with good grace listen to a radio account with no more harm than having their emotions thrilled as never before.

THERE were clerics, too, in many rows at the Polo Grounds. What more natural than that young fellows, recently from college, where athletics —including boxing—is in the curriculum, should want to see this interesting affair? So they went. Possibly their sermons were tinged by the "good fight" as were St. Paul's epistles by the sporting events of his day; but that matters not.

New York is used to excitement—lives on it; but it was hardly prepared for the succession of shocks which the Dempsey-Firpo affair produced. When a cool, collected broadcaster like J. Andrew White, famed for his mental poise, gets worked up there is something doing in radio. It was a night of excitement and from the first knock-down until the last count events transpired at such a reckless pace, including the champion's tumble into the lap of Grantland Rice outside the ring, that no one could resist the onward rush of events.

Those breath-taking descriptions of previous ring encounters amazed us by their delivery in low, incisive tones. But this time precedent was thrown aside, and listeners got a mental picture of the observer rising to his feet with each word shrilling the intensity of the drama unfolded—whew! it must have been some shindig!

All the radio world went awry; listeners howled and shrieked and went wild.

MILLIONS there were who "saw" the battle only with the eyes of the radio announcer, for the ringside microphone was hooked up with three stations and every word and sound was transmitted simultaneously from WJZ, New York; WMAF, South Dartmouth, Mass., and WCAP, Washington, D. C. The interest was not confined to the cities. The country districts are as much wrought up over radio as the metropolis and when a star event like this was to be put "on the ether" they became doubly enthusiastic. Scarce a hamlet in the Eastern half of the United States but had one or more loud speakers set up to the street with a crowd listening and cheering and going wild as at the ringside.

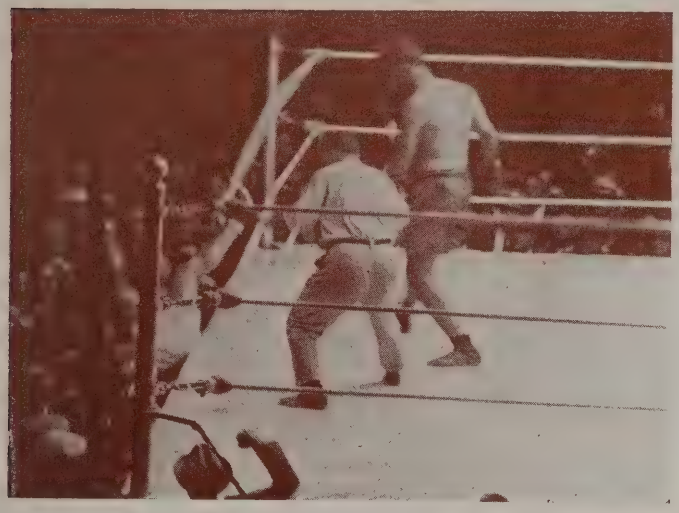
In New York City it seemed as if every single person wanted to listen. Most of the radio shops outside of the strictly downtown business districts gave a "party," having a loud speaker either rigged up for a street audience or for all who could crowd inside.

For several days the fight was the chief topic of the radio bugs. One

Millions Breathless

Argentina Heard and the Whole United States Listened At Home, In the Streets and In Theatres for Five Epochal Minutes

Scofield Wood



Above, a typical group of home listeners, snapshotted by Arthur Page, of Nutley, N. J. Below, the sensational knocking of the champion through the ropes

would hear such conversations as these:

"Say, Bill, what do you say if I drop over tonight and listen in on the fight?"

Or, "Oh, Jack, I'm giving a little party for the fight tonight—by radio—and you're in on it."

FOR the same period of time the radio dealers were hard put to supply their patrons with parts. One can only guess how many new sets were sold, but it's no guess how much they sold of parts, such as batteries, tubes, phones and loud speakers. They sold out! It was exactly the quantity of each article they had in stock. On the day of the fight dealers and their clerks were scurrying around town trying to beg, borrow or steal these commodities, and price became a matter of no consideration. Ten dollars for a "B" battery is going some, but one buyer paid it, right before my eyes, saying he just had to have it. Dealers could get what they asked for tubes, also; with none obtainable that last afternoon. Radio sales had a boom such as it never had known before.

Several of the theatres capitalized the fight. There was the Circle, in New York City, for instance. To test the popularity of the thing, the management installed the best set they could get hold of, inadequate and inefficient, but, as it proved, capable of producing a thrill when the fight came. The plan was that the regular musical and movie program was not to be interrupted by the radio news from the ringside. When the main bout came a movie thriller was being shown, but it might just as well have been stopped. No one watched the picture, no one cared a thing about what their eyes saw. Through their ears they were "seeing" things of much more interest. And when the final count came they were all on their feet with a shout that disconcerted even the case-hardened traffic cops on duty at Columbus Circle.

Sitting next to me in the theatre was a large blond lady. She had been getting more and more nervous as the situation grew tense. When that "TEN" came thundering in she simply went completely daffy. With a loud whoop and a grand swoop she grabbed me around the neck—and no more can I profess that I have never been kissed! That was all—except my blushes, for she fled precipitately, leaving me in confusion, and wondering.

Was the show a success from the manager's standpoint? I'll say it was. Every one of the 1,500 seats was filled.

THIS theatre has announced that it will install a real receiver and loud speaker before the next event of the kind is broadcast and expects it will prove as much of an attraction as it did for the Dempsey-Firpo affair. Other theatres which tried it out, make much the same kind of a report and it is safe to say that many other installations will be made and radio become a regular feature of the performances, of course, when anything big is on the air.

The *Staten Island Advance* invited folks to come to the square in front of that office to hear the returns of the fight. Haste in installing the receiver and loud speaker marred the early part of the show. The announcement of the preliminary bouts was chiefly noise. Electrical difficulties puzzled the ones in charge and they did not get it all straightened out when the big bout was put on. But this came through fairly well and as the crowd had stood by in spite of the trouble, there was a large, uproarious time had by all.

Now all this happened, not solely because of two men pitting their skill against each other within a ring, though they were essential, but because there was a third man beside the ring who was able to make vivid to the listening millions the things which were occurring with lightninglike rapidity before him—J. Andrew White, the father of sporting entertainment by radio. He is the pioneer, and still the peer of broadcasters.

THERE is one particularly distinctive thing about these boxing descriptions: It doesn't seem at all brutal by radio. One does not see the blood, if there happens to be any. There is nothing at all of physical distress by radio and there is all the thrill left.

Why is it that the radio has so transformed folks that a prize fight is now the proper thing for society, banker, merchant, lawyer, or preacher; that it is considered proper for the home; that the ladies have been charmed by the contest and have become ardent fight fans, so that many of them even go to the ringside? Probably to thousands the sight of a boxing contest even now would be objectionable; they could not stand the thing, for there would be memories of brutal fights outside the ring, and a stigma which attached to it from which they could not rid their minds. But by radio this is missing, and a clear-cut, snappy account of what is transpiring in the ring sets the blood tingling, without producing a revulsion of feeling.

What surprises us all is the way the ladies take to it. Of course, they had been prepared for it in part by

war-time activities, which changed their viewpoint of many things. But no one dreamed that they would "fall" for boxing and go as absolutely crazy as the men folk over a championship bout as they have. There is but one explanation, and that doesn't explain: The Radio Bug bit 'em and they took whatever came through the air as a matter of course.

But why did the maiden lady talk about the beastly, brutal, sinful affair and then hug the loud speaker and shout with the loudest when Major White's account came through? We leave it to the reader. Perhaps that's the reason—Major White.

Incidentally, the *New York Evening World* used the radio for reception and put it through an amplifier for the crowd in front of the Pulitzer Building, and it beat the ticker service by five minutes all the evening.

An interesting feature of the broadcasting was the manner in which the announcements were sent to Argentina. Far from the scene of the battle, more than six thousand miles from the ringside in New York, some of the most eager fight fans listened tensely to a blow by blow description of the supreme fistic engagement of the year. And this invisible audience was Firpo's own, those who inspired him to enter the ring against Dempsey, confident in the belief that their giant brother would trot back to the pampas with the world's heavyweight championship title. Disappointed, but with the satisfaction of knowing that the challenger fought bravely in defeat, they caught the result made known to them by radio over their receiving sets through the intermediary of the most powerful radio station in the world, Radio Central, located at Rocky Point, Long Island.

The manner in which the transmission of this precious information was carried out during the many stages of its progress over telephone wires, telegraph circuits, and the many transformations of voice and telegraph signals is represented schematically in the chart.

The Audience Pictured in Paragraphs

Arthur S. Page, of Nutley, N. J., eloquently expressed his appreciation by sending a souvenir to Major White, in the form of a photograph of the listeners at his home, a flashlight developed at midnight and the print made before breakfast, so it could accompany the warm note of thanks.

The Chesleigh brothers, who operate station 2AEE, in Brooklyn, had fifteen guests and neighbors listening for a block in each direction and all reported perfect reception. They thought: "It certainly topped everything we have heard, and that includes going back to the Dempsey-Carpentier contest."

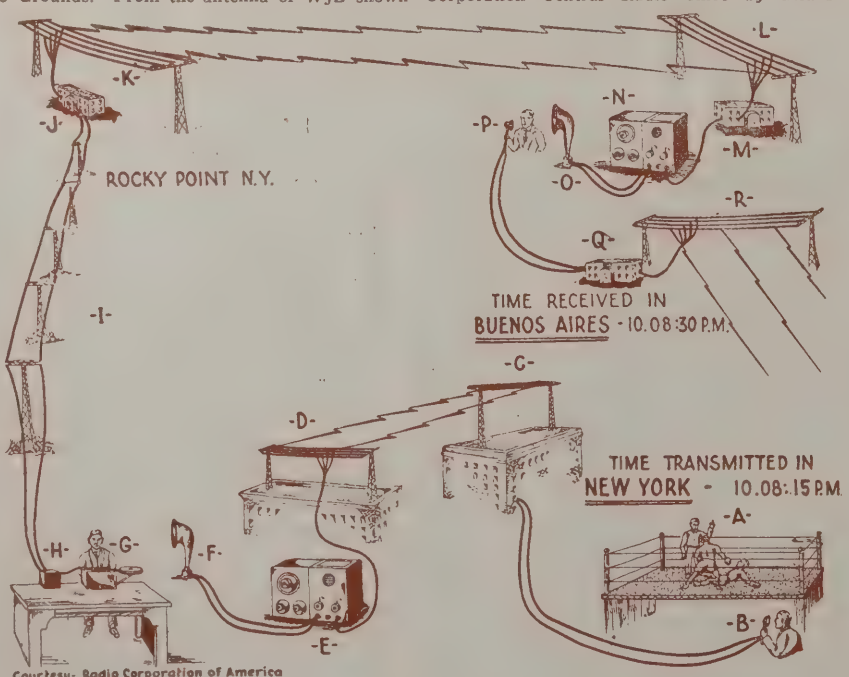
The N. Y. Edison Company fans executed a testimonial of appreciation of the "hair-raising description rendered," with fourteen signatures attached.

Louis Elkins, of the Bronx, N. Y., who had fifty guests at his home, proclaims Mr. White the peer of radio announcers, adding: "It is beyond imagination for those who did not listen in, to understand just how good his description was, embracing as it did, moments dramatic, humorous, personal, appealing and exciting."

Henry Hoyt Moore, a Brooklynite, got all tangled up in a conflict of emotions. He wrote a letter stating that fistic combats were brutal, but, at that, much less revolting than the bull fights of Firpo's mother country, to which he added the admission, "we are all interested and absorbed despite our-

How the Fight Results Were Flashed to Argentina

Dempsey and Firpo clash in the ring shown at "A." While the battle rages, J. Andrew White, the announcer stationed at the ringside at "B" describes the mighty left and right blows exchanged between the champion and the challenger. Each movement within the ring is translated into a word picture by White which is transmitted over the line through the microphone at "B." This land line connects with the Radio Corporation station WJZ located several miles from the scene of the engagement within the Polo Grounds. From the antenna of WJZ shown at "C" radio waves laden with the precious information given by White are hurled outward with the speed of light to be intercepted by thousands of receiving antennas scattered throughout the United States. A few miles from WJZ, the antenna shown at "D" receives a minute portion of the energy from "C" which is received by the broadcast receiving apparatus "E." After sufficient amplification at this point the blow by blow description of the bout is projected into the transmitting room of the Radio Corporation Central Radio office by means of the loud speaker "F." An operator intercepts White's word messages and transcribes the words received into dot-dash language which is recorded upon a tape by means of the perforating machine "G." The tape is then instantly fed into an automatic high speed transmitting machine connected directly in the control line extending to the giant radio telegraph transmitting station at Rocky Point, Long Island. This line, represented at "I" links New York City with the three mile multiple-tuned antenna and two Alexanderson alternators which deliver 700 amperes to the antenna "K." Thus White's voice message is converted into telegraph characters and the waves radiating from "K" on 17,500 meters are an amplified telegraphic repetition of the short wavelength energy broadcast from the antenna "C" at WJZ.



Courtesy- Radio Corporation of America

The system made up of the waves the radio generators at "J," and the antenna at "K," elevated 750 feet above the earth on twelve steel towers, forms one New York terminal of the RCA trans-Atlantic radio system. During the period of the bout, however, its signals were intended for the high power receiving station at Buenos Aires. Thus, 6000 miles away, the powerful wave energy flung from the antenna "R" registers at the receiving set "N" through the Monte Grande antenna represented at "L." Over great expanses of water and long stretches of land the progress of the big bout described by White journeys to the native land of Firpo. But the circuit is not yet complete. The telegraph signals issuing from the loud speaker at "O" must be converted back from that staccato language into the very words which White delivered to his microphone. This is carried out by a telegraph operator-announcer. He is stationed in the studio of the RCA broadcasting station shown at "O" where he translates dots and dashes into a word description. The antenna at "R" flashes his announcements to eager listeners sitting beside their short wave receiving sets.

The range of this station is sufficient to carry the news of the battle at New York not only to radio fans in the Argentine, but to Chile, Paraguay and Uraguay.

From the moment the referee reached his tenth count while Firpo lay upon the canvas after a blow delivered by his opponent, only 15 seconds were consumed in transferring the news from New York City to the countries in South America first mentioned.

selves. If such brutal things must be broadcast, then by all means get a good man like White to do it." Before the letter was mailed, Mrs. Moore apparently was consulted, and the following postscript appended: "On reading the above to the wife, she says: 'Don't send that. Your ears were glued to the head-set, and you know you wouldn't have missed it for anything. Mr. White's description was masterly.'"

Harold Hillis, of Jefferson, N. Y., embroidered his written thanks with the gift of a box of smokes—calling them "life savers" for the strained nerves of the radio observer.

At Fort Humphreys, Va., the Signal Corps installation was placed in the Liberty Theatre. The post has a command of 500 officers and men, but 900 persons crowded into the theatre, civilians coming from the inlands for fifty miles around.

The bout brought a vision to E. Young, of Highland Mills, N. Y., that the hundreds of thousands who "saw" the fight through radio had to depend upon a single pair of eyes, which, "never for a fraction of a second wavered!"

A. Engles, who listened-in with his family at Chicago, comfortably seated in his room, said: "This one reception has more than repaid me for the expense incurred for my set."

Albert T. O'Connor, of Taunton, Mass., who had twelve guests, observed to Major White: "I was glad that you got excited yourself; you never have been excited before in any of the bouts. I nearly fell out of bed myself, and I have been in it for eight years."

John Collins, of Millville, Mass., thought: "It seemed strange that you could be so calm while we could hear so many excited remarks from the ringside. I think I heard you strike that trick match you brought from Atlantic City when you lit your cigar; it put me in mind that my own pipe was out. Tim McNamara, of the Boston Braves, who is home with an injury and who was listening with me, said he never saw a ball game in his life that gave him one-half the thrill that he got in the few minutes the fight lasted."

F. W. Warriner, writing from Tyrone, Pa., feels well acquainted. "Andrew was wonderful," he remarks. "Checking up his words with the later reports, he was like a flash and absolutely accurate. He gave me as good a time as he had himself."

The skilled observer for the great heavyweight boxing contest made a close study of both contestants at their training camps and in advance of the big event itself told the radio audience many interesting and intimate things about the personalities and lives of both champion and contender. At the left, Mr. White instructs Jack Dempsey on the operations of a radiotron and Radiola Senior, and at the right, he bids Firpo farewell at the conclusion of his visit to the Argentine's camp.

Among the unfortunates was Louise F. Smith, of Brooklyn, who dictated her note of appreciation with the opening sentence: "I cannot see the light of day, but I saw the whole fight as you described it over the radio. Your controlled excitement at the last made a splendid climax." She pleads then: "Please don't ever translate any bullfights or cannibal feasts over the radio because I am afraid I would get wildly interested." After which comes the request: "But if you ever do, let me know."

Out in Missouri, at Washington, Powell Ross let a large crowd listen at his store, getting the returns through WJZ "fully a half hour before the other stations gave any details."

Helpless, an invalid for 13 years, James de Voe Wilkins, of Port Chester, N. Y., dictated a warm note of thanks on behalf of himself and twenty-two friends, saying that they almost "smelled" Mr. White's cigar.

Ruth Burton's appreciation took the form of commendation for the ringside observer because, "He was intelligent, refined and dignified and did not indulge in any vulgar 'gallery play,' which many people would have deemed necessary on such an occasion."

George M. Newcomer, of New York, heard the description with "inexpressible amazement at ability so accurately to describe the occurrences of probably the most exciting five minutes ever experienced."

Harry J. Shine thought that no one could match Mr. White's description, whom he refers to as "the Jack Dempsey of the broadcasters."

One hundred patients gathered in Surgical Ward 2 of the N. Y. Post Graduate Hospital, heard the fight description through the receiving set of Jack Hajim, a fellow patient, and expressed their gratitude by saying, "without the radio we could not forget our pains."

At Albany, N. Y., a radio party was given by Martin F. Grumbly, who termed the fight broadcast "the most interesting program ever sent out" because all the guests "were laughing at Mr. White's funny remarks" during the preliminaries and then during the big bout there was pandemonium, for as Mr. Grumbly expressed it: "Never could an announcer get one so excited as he did!"

Laurence J. Hutchinson, of Malden, Mass., doffs his hat with the observation that "the humor of Mr. White in describing the preliminary bouts was original and witty, but the description of the big bout was the finest piece of work I have ever heard over the radio."

When Japan Called for Help!

With Disaster Overtaking the Nipponese All Other Means of Communication Were Silenced But Radio Reached Round the World

By J. O. Smith

The transmitting section of the Iwaki plant at Haranomachi which supplied the world with details of the great catastrophe. It is ordinarily controlled from Tokio, but owing to the destruction of the connecting land wires, its operation was carried on from Tomioka, the receiving unit of the station

CQ—CQ—CQ—de JAA JAA JAA—

The frenzied voice of Japan calling. There was desperation in the tone of the radio flash to the wide world early on the morning of September 2. Never in history has a twelve-hour period of silence, such as preceded the call, been broken with a more startling and stunning message than immediately followed.

It told a story of earthquakes, fires, floods and general disaster that has had no parallel in a decade. And through the days of anxiety and anguish that followed radio remained the only reliable connecting link between the stricken land and the outside world.

The first word of the great Japanese disaster came in a short message from the Japanese Iwaki trans-oceanic station JAA, 144 miles northwest of Tokio. It was transmitted to the Koko Head, Honolulu, station of the Radio Corporation of America, the first of the high-power Pacific stations to hear the call from stricken Japan. The message was brief, but of great portent:

CONFLAGRATION SUBSEQUENT TO SEVERE EARTHQUAKE AT YOKOHAMA AT NOON TODAY WHOLE CITY PRACTICALLY ABLAZE WITH NUMEROUS CASUALTIES ALL TRAFFIC STOPPED.

Immediately upon receipt of this message, the operator at Koko Head retransmitted it to KET, the Radio Corporation's station at Marshall, Calif., 44 miles from San Francisco, and it was instantly received over "tone" land wires, without retransmission, at the main office there.

The importance of the message, after twelve hours of silence on the part of the Japanese station, with which continuous commercial traffic is ordinarily exchanged by KET, was instantly recognized. The manager of the station, George Baxter, and the entire operating personnel were hurriedly summoned, for it was quickly realized that a deluge of messages and press dispatches would follow.

The brief message was given to the San Francisco newspapers and to the press associations; and soon the entire United States, and the rest of the world, was informed of the great catastrophe which had fallen upon the Land of the Rising Sun.

As the hours went by it developed that radio was the sole means of communication with the stricken land, the Pacific cables having failed at a point about 80 miles from Yokohama.

The demand for more information became acute. The hours went by, and hundreds, then thousands of messages, from everywhere, began to pour into the offices of the Radio Corporation. Repeated calls by KET, however, brought no reply from JAA, and it was feared that disaster had also fallen upon the only connecting link with the stricken land.

Details are lacking at this time, but it is not hard to imagine that such severe earth disturbances as were experienced short distances away might easily have caused trouble at the big Japanese station. Possibly those intervening hours between the receipt of the first message, 6:10 A. M. Pacific time and 4 P. M., when JAA again answered the continuous calls of KET, were hours of feverish hard labor for Superintendent K. Yonemura and his staff in getting the big plant back into operating condition. Once communication had been re-established, Mr. Baxter sent the following brief message:

WE WANT DETAILS GIVE US FACTS.

Yonemura replied that all possible information would be given as quickly as possible and from that time on, after the whole world had anxiously waited almost a full day, the story of the disaster began to come haltingly through. Japanese was slowly translated into English, with the horror of the picture painted in the cryptic expressions of the unfamiliar translator, shocking and stunning an entire globe.

Traffic was all in one direction, eastbound, as Yonemura had stated in a very short, concise message there was no use sending traffic for Japanese delivery—"Delivery here hopeless." All land wires were down and JAA was unable to get replies to repeated calls to other Japanese radio stations in the region of the disaster.

For many days Yonemura, through JAA, continued to be the only connecting link between Japan and the outside world, being the only man on the station's staff who could translate Japanese into English for transmission. As the time went on he continued to supply the rest of the world with details of the great disaster as

Trans-oceanic operating room of the Radio Corporation of America, Honolulu, where the first news of the great Japanese disaster was received

refugees and couriers began to arrive from the stricken area.

But for the services rendered by radio during the great emergency the rest of the world would have been without knowledge of it, or, certainly, without details for a week or more.

In addition to supplying a constant stream of information to San Francisco, Yonemura frequently sent a lot of reports to Pekin. The latter station, XYZ, as well as JAA, were both plainly audible at the offices of the Radio Corporation in San Francisco.

Yonemura also performed another special service which earned him the gratitude and praise of thousands of relatives and friends of the passengers on the great Pacific steamship *Taiyo Maru.*

The vessel, with a large American passenger list, sailed from San Francisco on August 21 for Yokohama, which should have brought her in the vicinity of the earthquake at the time of its occurrence. Shortly after the details of the disaster had become available the steamship was heard to broadcast an SOS signal. Nothing further was heard of her.

The consequent fears of the relatives and friends of those on board resulted in a deluge of demands for information and to satisfy them the San Francisco office of the Radio Corporation, through KET station, sent insistent demands for further information to Yonemura at Tomioka. The latter, although sleepless for days and worn out with incessant effort to give the world details of the great disaster, succeeded in getting in touch with the Japanese Government station at Choshi. The latter station finally, after many long, weary hours, finally got into communication with the *Taiyo Maru,* which reported that she was safe.

The information was forwarded to Yonemura, who, in turn, relayed it to San Francisco, relieving the fears of those who had relatives and friends aboard.

The reason for the SOS from the *Taiyo Maru* is not known at this writing.

The Iwaki radio installation, which was virtually the sole link between devastated Japan and the remainder of the world, is a new and highly modern establishment. Its sending station at Haranomachi has a concrete mast 660 feet high, which, strangely enough, seemed undamaged by the earthquake.

The receiving station is at Tomioka. This is 155 miles from Tokio and twenty-four miles from the Haranomachi station, which is farther north. Both Tomioka and Haranomachi are small towns near the eastern coast of Hongo, principal island of Japan.

T. Yonemura, superintendent of the Iwaki trans-oceanic station at Tomioka, Japan, who supplied the world with details of the great disaster and worked continuously without rest or sleep for four days

The Haranomachi station's mast is hollow, fifty-five feet in diameter at the base and four feet in diameter at the top. The walls at the base are four feet thick, tapering upward with a decrease in the mast's outside size.

From this giant mast, which dominates the flat rice lands of the countryside for miles around, sixteen wires, the basis of an "umbrella type" aerial, radiate to smaller towers, 200 feet in height and 1,320 feet distant. The

The 600-foot concrete mast of the transmitting section of the Iwaki plant at Haranomachi, which was not damaged. It is 55 feet in diameter at the base and four feet at the top

Japanese government owns the station and operates it, so far as its connection with this country is concerned, under a traffic arrangement with the Radio Corporation of America.

Normally the station erected in 1921 communicates with America through the Radio Corporation's station at Honolulu which, in turn, relays the traffic to that company's station at Marshall, across the Golden Gate from San Francisco. In the recent emergency, however, practically all communication was carried on direct between Iwaki and Marshall.

Reception at Tomioka is over a standard Radio Corporation set, connected to a Beverage wave-type aerial. This set was built in America and picks up and retransmits the incoming wireless signals over land lines to Tokio, so that no manual relay is necessary.

The trans-oceanic station of the Radio Corporation of America, which handled practically all of the great amount of traffic to and from Japan following the emergency, is composed of two parts. The transmitting section is located at Bolinas, Calif., and the receiving section at Marshall, both about 50 miles from San Francisco. All incoming signals are automatically transferred to "tone" wires at Marshall, the actual receiving being done at the San Francisco offices of the Radio Corporation. The transmitting unit at Bolinas, consisting of two 100 k.w. Alexanderson high-frequency alternators, is also controlled from the San Francisco offices.

Wireless Warnings of Iceberg Danger

United States Coast Guard Ice Patrol Functions Exclusively By Radio—Changes Course of Steamers to Avoid Floating Ice

By Ortherus Gordon

YEARLY, when the sluggish Labrador Current shakes off the frozen grip of the north and "seems to feel the thrill of life along her keel," it brings down to our latitudes huge detached portions of the polar cap, each one of them an iceberg large enough to send the largest ship to the bottom. Every Spring two vessels of our Coast Guard fleet sally forth to meet these unwelcome visitors, to number them, watch their every movement, warn shipping by radio of their unexpected pranks and thereby make life at sea safe from their chilling and deadly embrace. Radio is the most important single element in protecting commerce from the iceberg danger. In fact, radio's service in transmitting ice warnings is exceeded in importance only by the aid it gives when a ship is in actual distress. Radio ice warnings have undoubtedly saved thousands of lives, all unknown to the passengers who so gaily sail the Atlantic.

Each of the two vessels charged with the duties of the Ice Patrol in the north Atlantic is on patrol for 15 days at a time, not counting the day or so spent in going to and from the temporary base at Halifax, and during the three months of the iceberg menace, each vessel sees sixty-three days of cruising. Last year the *Seneca* and the *Yamacraw* were assigned to the work, which began on April 2 and ended on June 30. At that date, the danger was pronounced negligible, and the trans-Atlantic shipping lanes, moved south as an additional precaution, were shifted back to their original latitude, sixty miles to the north. It has been discovered that every June the weak Labrador Current, after a losing struggle with the swift Gulf Stream, beats a slow retreat, and the bergs that formerly moved south with the current, share the retreat and turn north, which takes them far above the ordinary lanes for steamship traffic. The need for the Ice Patrol then disappears, and the particular vessels on the beat join the remainder of the Coast Guard fleet on the Atlantic seaboard.

While it lasts however, the need is an urgent one. We were taught so to our sorrow in 1912, when the proud steamship *Titanic* crashed into an iceberg and went to the bottom with many of the leading men of England and America. Whatever additional lessons that disaster carried in its wake, it brought home to an appalled world the sinister and newly realized danger of the Polar ice in the Spring. A demand for protection against the bergs immediately arose on both sides of the Atlantic. Hitherto considered by navigators as but one of the hazards of the sea and disregarded by shipowners, the iceberg in 1912 became known as an international menace, and at a conference held in London in 1913 the maritime nations represented concluded that something must be done. The United States was there—and told the conference that for two years she had patrolled the ice region on her own account, and had been taught one thing about the job. That was that one ship equipped with radio was as efficient a patrol as the North Atlantic fleet not equipped—provided that all other ships were fitted with radio as well! The problem of the Ice Patrol, it was stated, was solely one of communication. The conference listened to the story and then passed the whole responsibility into the hands of our country, so that the patrol for 1914 was conducted by our ships and our men, but was paid for by the thirteen powers interested in trans-Atlantic navigation. This arrangement has

Radio is the most important single element in protecting commerce from the iceberg danger and the Coast Guard vessel seen in the photo, the "Seneca," cruises for sixty-three days among these unwelcome visitors, to number them, to watch their every movement and warn shipping of their presence by radio

held for every year since then, although the issues of the Great War have altered the number of nations sharing the expense.

The work must all be done by radio. Think of Boston and New York being entered from the East by scores of steamers daily, and think of dozens of itinerant and irresponsible icebergs floating downward across their path. The problem is not only for the ice patrol to know the position and drifting habits of each and every berg, but to transmit that information to each and every ship entering the danger zone. Right away there appears the "makin's" of a mighty job—and every single bit of it, aside from the actual sighting of the bergs and determining of their drift, is accomplished by radio. That's the important part—getting the words of caution, the warnings, the commands, to the ships that are running straight into danger.

"Will all ships within call and entering the ice region communicate their position, course and speed, together with temperature of water, to the U. S. C. G. S. *Seneca*, doing duty as Ice Patrol, now in lat. 42° 12′ N., long. 51° 20′ W.?" Every four hours, while on duty, the *Seneca* or the *Yamacraw* broadcasts this request, and in response all the ships within range, perhaps thirty of them, send in the information required. Immediately the various ships, according to their latitude and longitude are plotted on a large chart of the waters south of Newfoundland and east of Nova Scotia. The Ice Patrol then has a graphic picture of the commerce plying the ice-infested waters and in need of protection.

When Mr. Iceberg is sighted, he too is spotted on the chart, and from that time forward, his movements are watched with the greatest concern. If the chart shows that the iceberg and a ship are due to meet, a warning is flashed directly to that ship and a collision averted. As more and more ships appear on the chart, and more and more icebergs come down from the north, the job of keeping the one clear of the other becomes a bit complicated. To say that it requires constant vigilance and untiring endeavor is to give downright hard toil a fancy name. The amount of radio work entailed is nothing short of stupendous.

Aside from the great volume of traffic with steamers, there are reports that must be sent to Headquarters. Every morning at 4 a. m. a message leaves the *Seneca* or the *Yamacraw* addressed to the Branch Hydrographic Office in New York. It is routed via the naval radio station at Otter Cliffs, Maine, and is transmitted on a wave length of 952 meters—either that or 975. This report is a diagnosis of the ice situation at that moment—taken from the chart, which is always up to the minute—with the areas that will be affected during the coming day by drifting bergs. That such information is appreciated in New York is evidenced by the lengthy list of shippers, merchants, and others who want it mailed or delivered to them by special carrier. That its importance is not disregarded by the Government is shown by its ultimate end, which is a broadcast over a considerable portion of the earth's surface from the huge station at Arlington, Va.

Throughout the day, the ship on patrol collects and disseminates information on the floating menace. In this she is aided by the many hundreds of vessels which use the steamer lanes each month. If the *American*, for example, narrowly misses an unreported iceberg in lat. 42° 50′ N., long. 47° 12′ W., she doesn't merely thank God and double her lookout. She determines the latitude and longitude of the "critter," makes up a more or less scary report on its characteristics, and sends it by radio to the coast guard cutter on duty. At the same time, by way of showing that she isn't the least bit tremulous, she asks for the position of every "growler" or iceberg ahead of her! Of course, the information is forthcoming, and a fresh berg plotted on the chart. A broadcast is sent out immediately, and everyone within range is warned of the latest arrival from the Polar regions. Those ships whose courses show that they will pass close to the reported location of the berg are favored with a special warning, which they must acknowledge and report their action. As soon as practicable, the ice patrol ship verifies the existence of the iceberg, determines its drift, and places it permanently on record until it has melted to nothing, or has returned to the north whence it came.

Farmers' Night at WGY

SOMETHING different in radio programs was offered Thursday evening, September 6 by WGY, the Schenectady station of the General Electric Company. It was "Farmers' Night" and the program consisted of the entertainment, musical and otherwise, which might be expected at the home of a prosperous farmer and his faithful wife on the observance of their fiftieth wedding anniversary. Josh Quinby and his wife Samantha received their friends and the radio program consisted of the singing of old time songs by the Cowbell Four, orchestral numbers by the Cornhuskers orchestra, and a speech by Josh himself. The program was continuous.

Receiving Sets for Icebound Arctic Posts

THOUGH icebound and in darkness through the long winter months of the Arctic regions, trading posts there will not be entirely isolated from civilization and life. According to plans made by the Hudson Bay Company lonely posts will be provided with radio receiving sets so as to secure entertainment at any time. Two northbound ships, the S. S. *Bayeskimo* and the S. S. *Nascopie*, are carrying Westinghouse radio receiving sets to six of the posts above the Arctic circle.

In order to determine whether or not these posts will be able to hear the concerts from the United States next winter the ships are listening in on their way North to the broadcasts as they steam to the frigid zone. Several nights ago the Westinghouse station WBZ in Springfield, Mass., gave a special concert at 11 o'clock, and radiograms received from the steamship *Bayeskimo* state that the music has been heard with great success.

There are hundreds of posts spread throughout Canada and North America from above the Arctic Circle into James Bay. The ships have left for these trading posts, and the factors will have their sets for next winter. Although the reports received so far from the ships are very encouraging complete information on the results will be obtained upon their return. The posts are so far removed from civilization that this will be the last news from the outposts until spring. The lanes of travel to these posts are entirely blocked on account of the heavy ice and snow.

Correcting Longitudes by Radio

THE position of Bordeaux on the map has been pushed 360 yards westward as a result of new calculations of its longitude made at the observatory there on the basis of wireless time signals transmitted by the Eiffel Tower in Paris. Previous calculations of the longitude of Bordeaux had placed the city on a meridian 2 minutes 5.51 seconds west of Greenwich, but correction by wireless proves the correct longitude to be 2 minutes 6.554 seconds west, an increase of fifteen seconds of arc. The length of a second of arc varies from zero at the poles to 101 feet at the equator, and at the latitude of Bordeaux is seventy-two feet. Fifteen seconds thus means a change of 360 yards or approximately a fifth of a mile.

Astronomers say that wireless time signals are being used to correct longitudes all over the world, with the result that boundary lines are being altered in many cases.

Blame It On Radio!

By Carl Dreher

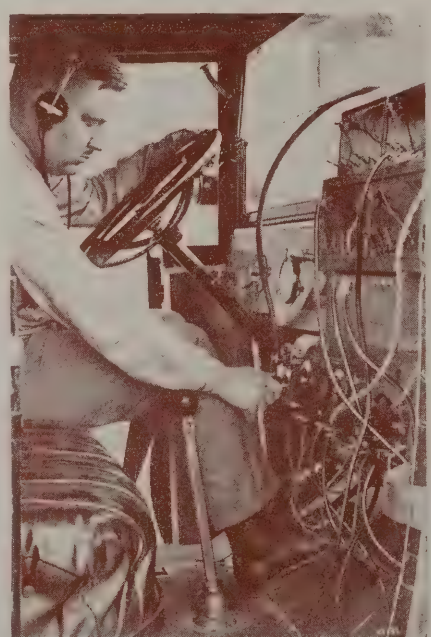
That radio waves may have any physiological effect is disproven by the fact that the laugh of Miss Louise Lorraine pictured above uses up several hundred times more energy than is contained in any ordinary unamplified radio wave

AT one time men blamed everything on the stars. It was assumed that the stars in their courses determined the issues of battles, the state of the potato market, and whether grandfather would sink or swim when thrown into the castle moat with all his armor on. This belief was a good thing for the astrologers and they made quite a little money out of it in their day. In fact, some of them are still making a living out of it, though on a reduced scale. People can be found to believe almost anything, and, after all, no one can prove conclusively that the heavenly bodies do not influence human affairs, Sirius and the Pleiades being too far away to venture an opinion.

In our day, however, the stars have lost much of their prestige, while radio has captured the public imagination and become the repository of many hopes, as well as the cause of many fears. Both, I dare say, are much exaggerated.

A good example of the latter is contained in a dispatch from the Paris Bureau of an American newspaper. The article is headed, "French Believe Germans Have Way to Force Down Their Airplanes," and hints darkly at a "mysterious magnetic area which renders control practically impossible," and the conclusion is drawn that perhaps "German science has made another great discovery, the details of which are being kept secret, but which is being used against French planes."

Airplane motors run in the neighborhood of 400 horsepower apiece, which is about one and one-half times the power of an Alexanderson alternator, such as is used in telegraphing across the ocean by radio, on full load. Probably in noise alone the output of an airplane motor greatly exceeds the full radiating power of a large broadcasting station. Elementary physical sense tells one that the Germans could not charge any considerable area to this extent, even if energy transmission by radio were a reality. If they had means of doing that the German mark would speedily rise to its pre-war level. It is clear that any direct opposition of the energy supplied to the propellers of the planes, by radio transmitted power, is out of the question.



Experiments have demonstrated that the metal frame of an automobile will accumulate a high-frequency charge if placed directly under the antenna of a high-power trans-oceanic station, but if placed 100 feet either side of the antenna no effect whatever can be detected

The planes might be forced down, however, by power transmitted on a somewhat smaller scale, by interference with the ignition system of the motors. At one time a report came from the German high-power station at Nauen that difficulty was experienced in operating automobiles in the neighborhood of the antennas, owing to inductive sparks which exploded the gasoline vapor at the wrong points in the cycle. At American stations of equal power I have not observed this phenomenon, but it is true that sparks may be drawn from the metal framework of a car directly under the antenna, by a person standing on the ground. The chassis, being insulated from the earth by the tires, receives a considerable radio frequency charge. It is practically impossible to work on a car in this location, as one gets a moderately severe shock every time a metal part is touched. The same thing has happened when a small aerial was erected for broadcast reception at one of these super-stations. But these effects are in evidence only directly under the main antenna. If the car is rolled only a matter of one hundred feet to one side, there is no evidence of any charge, the field at this point being already too weak to manifest itself in this way. We may safely conclude that there was no interference at all with the French airplanes, but that a few of them happened to come down in this area, giving rise to the report cited. Flying is still a very hazardous business, as evidenced by the fact that practically every pilot, however prominent and skilful, must make forced landings at times, and almost all the aces developed by the war, who continued to fly after the armistice, have since been killed. In fact, flying

may be compared to DX work in radio; sometimes it is as easy as hearing the locals, while at other times it simply cannot be done; but in flying the corresponding occasions spell tragedy.

Power transmission by radio is in about the same class as the exertion of magnetic force at a distance. With a reasonable amount of power it is easy to design an electro-magnet capable of picking up great weights—but the object picked up must be in contact with the magnet. Such magnets are built and used commercially in this way. Attracting an iron object from across a room is another story entirely, for the force decreases inversely as the square of the distance. This operation, though often portrayed in humorous cartoons, is a fable. Workmen walk quite close to the enormously powerful magnets in the dynamos of power plants without having iron tools pulled out of their hands, or feeling any attraction. All that these giant magnets are capable of doing at this distance is to magnetize the work of a watch. The old Arabian Nights fable about the ship which sank when it sailed a few miles from a magnetic mountain, owing to the nails pulling out of the planks and flying over to the mountain, is a very good story, but perhaps it was just as well for the charming Scheherezade that the sultan had not taken a course in electrical engineering. About the same reasoning applies to power transmission by radio. While it may some day be realized, it should be understood that radio as we know it today does not afford any evidence to make one glow with optimism. Messrs. Nichols and Espenschied calculate in a recent engineering paper that over a distance of only a few hundred miles we can count on picking up not more than the one ten-thousand-millionth part of the energy radiated ($1/10^{10}$). Let it be noted also, that the progress which has made broadcasting and radio telephony a commercial proposition in our time, has been in substance simply the development of faithfully reproducing amplifiers for transmitting and receiving. The intervening medium has not changed in these two decades, and there is no reason to suppose that it will change, any more than the tides and the seasons and the other great natural forces of the earth. The modern radio circuit loses nearly as great a proportion of its initial energy in the space between the transmitter and the receiver as when Marconi made his first experiments. When it comes to power transmission, which means getting at the receiving end an appreciable amount of the power put into the transmitter, we are still forced to fall back on media more solid than the electrons of space—copper and iron.

However, the notion of power transference by radio has at least some rational basis, which can only be disproved by analysis and citing of figures. Some of the accusations brought against the art cannot be taken even as seriously as this. Recently an English lady of title delivered a denunciation against the broadcasting stations of her

Transmitting enough power by radio to disable an airplane at considerable height would probably destroy nearby human beings and objects before having any effect on the plane

country, maintaining that the waves killed song birds in flight. A bird would be flying along, according to her description, busy with his domestic arrangements, such as collecting material for his nest or feeding his offspring, and, meeting a wave from one of the nefarious broadcasting stations, would drop to the earth, quite dead. Why it had to be a wave from a broadcasting station, and not one from the far more powerful radio telegraph transmitters, was not stated. The incident reminds one of the shouts of alarm which rose when it was predicted that railroad trains would run at the apalling speed of twenty miles an hour, and the fact that an ordinance conceived on hygienic grounds, prohibiting bathing from November 1st to March 15th, failed to pass the Philadelphia Common Council by only two votes, not so many decades before the Civil War. The bird-lovers need not be unduly alarmed, for the birds themselves fly around and through the aerials of even high-power stations entirely unharmed, and, according to a recent report, a flock of them even alighted on the antenna of WCAP and actually changed the wavelength of the station without seeming to know they were there.

The days are past when radio was a mysterious force to the general public; now everybody thinks he knows all about it, and it has become so common that even a brand of mustard plaster has been named after it. At one time, however, radio was in about the same class as spiritualism, telepathy, and other wonders, and many insane people in the paranoiac class, or with paranoid tendencies, blamed "wireless" for their hallucinations and troubles. Their imaginary persecutors, they were sure, were shooting wireless waves through them, and that made them nervous. Although these fears have become less common since radio became a public utility, there was a case only recently of a young man walking into a large New York radio store with the complaint that radio messages kept coming into his ears, and what could be done about it? One of the salesmen advised him to put a little fine steel wool into his ears, explaining that this would absorb the waves. The unbalanced one was much relieved to hear of this cure, and went out to look for a hardware store.

Leaving the field of lunacy, many people are concerned about whether radio waves may be expected to have any physiological effect. The answer is negative, with very little room for doubt, for the reason that the energy of the waves is insignificant compared to the energy normally involved in physiological processes. An ordinary cough or laugh uses up more energy than is contained in any ordinary, unamplified radio wave—several hundred times as much, at least. If radio waves had any deleterious effect the operators and engineers of high-power stations should all be physical wrecks, inasmuch as they live constantly in far more intense electric fields than other people, but one has only to eat at the operators' mess for a few meals to be relieved on this score. It is only a question of time, however, when one of the indirect effects of radio on health will come into public notice. Some enterprising physician will discover a new disease, "DX fiends' sleepless sickness." While this is somewhat far-fetched, admittedly, it is a fact that appreciably more power is being sold for electric light in the United States, as reported by the National Electric Light Association, through broadcast listeners refusing to go to bed at hours formerly considered seasonable. It is not reported as yet that any broadcast listeners have disposed of their beds entirely, but there is no doubt that the manufacturers of beds and mattresses have reason to be alarmed.

Impressions from Paris

PARISIANS are being more and more enamored of their radio concerts and particularly of what are known as "Concerts Radiola," according to the French radio paper *Radioélectricité*. While the Radiola broadcasting station near Paris is not by any means the only one that is heard on the air in France, it is, according to the French publication the one that has transmitted the voices of the most celebrated artists and speakers.

A clever writer in a recent issue of *Radioélectricité* said some amusing things in a whimsical vein, which perhaps may be translated as follows:

"Oh! Well, my dear Radiolo, there it is—the fire is out and my coffee is cold, writes us a friend ravished of admiration. But at once I myself interrogate: a such enthusiasm has he really as to make to forget the fire and the coffee of all the listeners to the concerts, as soon as Radiolo speaks?

"For myself, I confide in you—such a grave error in domesticity merits being considered as a social cataclysm. It would be necessary to be a proud partisan of universal overturning to undertake each evening such responsibilities as the listening via radio, if we had not the certitude that the concerts radiophoniques far from throwing the disorder in the heart of the home, constitute the most inoffensive of divertisements, in the same time as a useful distraction.

"The public familiarizes itself with some works celebrated, and a happy innovation makes to precede each bit by a short summary of history and art, permitting the listener to sharpen his memory, and, often, to increase his knowledge.

"One has quickly taken the habit of tasting at home a pleasure that one used to go to search for at a distance and which would be strongly onerous if one did not find it at the domicile. . . .

"Ah! in what emotion would our fathers find themselves at the sight of this phenomenon if they could return! Just between us, I strongly suspect that after having tasted, with refinement mixed with stupefaction, the daily delights of the radiophone, they would demand suddenly of the Eternal Father the authority to regain the Elysian Fields if one should speak to them of the problem of reparations or the increasing of taxes. I swear that they would not be wrong! Without contesting, moreover, the power of the Hertzian waves, it pleases me to hope that an emotion of that sort is not reserved solely to the peaceful lovers of radiophone transmissions."

Another writer, in a later issue of the same publication, takes a more serious tone and analyzes the current performances and the trend of the times, as follows:

"The radio concerts are interesting, and are captivating the public more and more. That is due to the adroit manner in which the programs are arranged, so all the amateurs find it possible to satisfy their personal tastes. Little by little the performances are acquiring that character of unity that many of the listeners desire; little by little all the types of entertainment are being represented, the most serious as well as the most frivolous.

"At the same time the great anniversaries of musical history are celebrated in the most complete and dignified manner. After they mark the anniversary of the death of Saint-Saëns, we had the centenary of César Franck. While the Opéra Comique celebrated in a pompous manner the centenary of Edouard Lalo, Radiolo consecrated an evening to the works of that great French musician, with the assistance of Mme. Ducuing. A rather short but very compact recital, given over to a short biography and the performance of some of the works of Lalo, completed this artistic celebration.

"Programs of this type aid materially in comprehending the musical works that are performed. They not only give a resumé of the life of the composer, in which the outstanding facts of his history are made plain, but they cite interesting anecdotes connected with him or his works, and also include an analysis and commentary of the particular composition that is to be performed.

"When the orchestra played Beethoven's Pastoral Symphony, Radiolo explained to us in concise terms how this work had been conceived in the composer's mind, how it had ripened there, and had come to full flower in the work which we frequently enjoy, and never more than in our homes, by radio.

"The evening that was reserved for the celebration of the 23rd anniversary of the first performance of 'Louise' was particularly noteworthy. The musical program was exclusively devoted to the works of Charpentier. The master himself, who was at Bayonne, no doubt heard with emotion the radio transmission of this work that is so overflowing with life, and in which his youth is represented so triumphantly. But no one could have felt a more strong emotion than Mme. Rioton, who, twenty-three years before, had created the rôle of Louise, when, installed before the microphone, the honor fell to her of singing once more the famous aria. 'Depuis le Jour.'"

The Radiola concerts are broadcast from the Neuilly plant of the Société Française Radio-Électrique, located in one of the suburbs of Paris. The studio, however, is located in the office of the SFR in the center of Paris. A wave length of 1,565 meters is used and a power of 2 kilowatts. The concerts are usually given nightly between the hours of 8:45 and 10 p. m., Greenwich Mean Time.

Miss Nina Payne, American dancer, in her Paris home listening to the radio concerts broadcast from the Eiffel Tower

How Atlanta Prisoners Listen In

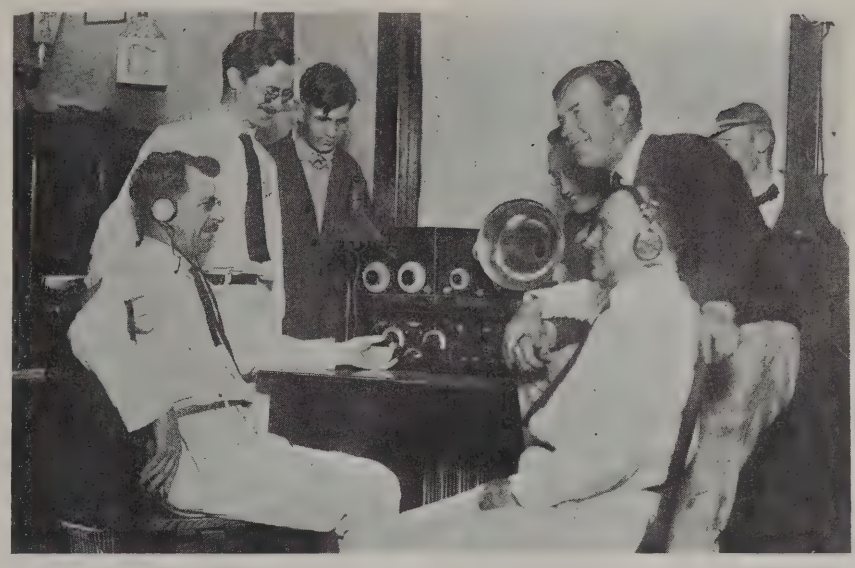
Radio Equipment in Federal Penitentiary, Atlanta, Ga., Does Its Share in Making Good Citizens—Symbolizes New Era in Prison Work

THE Federal Penitentiary at Atlanta, Ga., has a radio receiving set, with which it is able to hear not only the local stations, but many of the high powered transmitters located east of the Rockies. The apparatus was presented to the prison by several manufacturers, following the great success of the initial experiments performed last Summer. At that time the radio truck of the Atlanta *Journal* made regular visits to the prison yard, providing radio concerts through its loud speaker equipment. When winter came and the yard was closed, Chaplain (Father) Hayden was able to secure gifts of radio equipment for permanent installation indoors.

The effect of this is described as follows by one of the prisoners:

"From time immemorial men and women have devoted their lives to prison reforms, have striven to bring about the purpose of the law, which is not vengeance, and less of punishment than of reform. But throughout all the ages nearly all movements for the betterment of prison conditions have been aimed at lessening the physical punishment and giving little thought to or care for the mental punishment of imprisonment, which is by far the greater. If, when we enter a prison house, by the turning of a key, we could lock the door to the brain cells of memories, bitter and sweet, to the brain cells in which are hoarded the myriads of pictures of the past, and keep the doors locked till we pass out again, then, verily, the prison of today would hold but few terrors. But the haunting memories of the past, the bitter dreams of what might have been, rising like fireflies in the dusk, fastening themselves like leeches upon us throughout the long evening hours when no toil claims our thoughts, and throughout the silent watches of the night, constitute the real hell of prisons, the scorching flames of the furnace of vain longings and regrets that mar all men and benefit none.

"Not by brooding over a past irrevocably gone can a man shape the course of the oncoming years with even the glimmer of hope of success. Ashes and smouldering embers are poor foundations for the house of the future. And, hence, anything tending to break the chains that shackle a man to the skeletons of his past, that stirs within him new thoughts, new hopes, new illusions and, through them, new resolutions, is a movement that will carry in its wave a moral uplifting beyond the power of man to estimate.



The effect of radio in the penitentiary is described in this article by a prisoner, who terms it epoch making, because its entertainment brings smiles to lips that have forgotten how to smile and awakens aspirations for better and nobler ideals

"THE installation of a radio receiving station in each of the four vast cell houses in this institution is an innovation which should prove epoch making in the annals of prison reform. Music has tamed wild beasts of the jungle where the whip failed utterly. And music will bring smiles to lips that that have forgotten how to smile, will soften the hardening tendencies of the heart, will call forth ambition slumbering in the stupor of indifference, will awaken aspirations for better and nobler ideals. Too much credit cannot be given the sponsors of this movement for the moral uplift of the prisoners.

"The old prison methods were to crush the spirit in man, to strip him of his last shred of manhood, to rob him of every remnant of self-respect and self-confidence, and to turn him into a sneaking, skulking, shifty-eyed creature who, when released, would seek the dusky byways of the slums, shunning the light of God's sun. But the old prison system proved a boomerang that struck back at society. Now, in most of the penal institutions —though not yet in all—the methods are to trust men, to put them on their honor, to inspire self-confidence in them and thus fit them to face the future. And, verily, it is better to trust all humanity, even though we be deceived ten thousand times, than to distrust one of our fellow men. The aim of the present administration has been to trust a man till he proves unworthy of such trust. And let it be said in all truth that few and far between are those who have proven themselves unworthy of the trust placed in them.

"This policy of trusting has been evidenced in many ways—the latest being in permitting inmates to give a concert once a month at the Atlanta *Journal's* broadcasting station. The first concert was given on May 7th, 1922, when WSB was still a babe in swaddling clothes. Few, aside from its immediate neighbors, heard it. The second concert was given on September 30th at midnight. It had been widely heralded in the newspapers and from broadcasting stations all over the country and, when Lambdin Kay, the whiskerless announcer and favorite of all the broadcasting stations in U. S. tapped his gong and announced the program, a nation stood by and listened in.

"ACROSS the portals of the prisons of the past was written, invisibly, yet visible: 'All ye who enter, let hope depart.' Across the portals of the prisons of today is written: 'To ye, who are worthy of trust, trust shall be given.' "

Different Schooldays

A Radio Period Has Been Added to All the Readin' and Writin' and 'Rithmetic In a Newark School Whose Principal Recognizes Unrealized Educational Possibilities

By Helen Beckett

Martin L. Cox, the progressive principal, and two of the fortunate pupils

DON'T you wish you were a child again, back in your "golden school days, dear old broken rule days?" For now, added to all the readin', writin' and 'rithmetic, they are having a radio period. Of course, not every school is so advanced as to adopt this wonderful new thing as part of the curriculum. In fact, so far as is known, there is only one school that makes regular use of a Radiola Grand and that is the Robert Treat School in Newark, N. J.

Martin L. Cox, principal of the Robert Treat School, has imagination and vision and foresees the immense possibilities of radio as an instrument of education. The first graphophone to be used in any public school in New Jersey was installed in Mr. Cox's school and now the Radiola Grand stands beside it, a new proof of the progressiveness of the man.

His thirty-two hundred pupils, like children the world over, have a great interest in the many things that are not found in the pages of their school books, but which can only be discovered by turning the dials of a radio set. That is how it happens that the students themselves really secured the Radiola Grand for the school. When the Newark *Ledger* offered to the person or persons bringing in the greatest number of coupons one of these receivers, the Robert Treat pupils turned in no less than fifty-four millions, two millions of which were gathered by one lad alone.

One must be really inspired to want something so much and to work so hard to get it. Having earned it, the thirty-two hundred little radio fans feel a sense of ownership in it.

The Robert Treat School is organized on the Gary System, one feature of which gives every child a forty-five-minute auditorium period in each school day. That now may be called the radio period because, as the children file into the hall, the teachers who conduct the auditorium assemblies search the air by radio for some suitable entertainment or instruction, and they proceed with the regular schedule only if there is nothing appropriate on the air at the time.

"Often nothing suitable is being broadcast," Mr. Cox was regretful. "The great educational possibilities of the radio have just been recognized and the opportunity for influencing the child through public school radio programs has not been seized, certainly not through programs arranged for school children during school hours."

However, radio has been used during four different Commencement Day exercises held at the school. "I hope the time will come," said Mr. Cox, "when every graduate can hear the Superintendent of Schools of his city deliver an address on Commencement Day. This can be made possible only by means of the radio. Some day every child in the land will hear the voice of the President of the United States, the Mayor of his city and the Governor of his state deliver addresses, a privilege which we never had when we were children. When the leaders of our country realize that a half-million children are hearing what they say, what an inspiration that will be!

"Radio will also raise the standard of teaching, because if an instructor somewhere has a special talent for teaching a certain subject, thousands of children and teachers, too, in schools everywhere would be glad to listen in while this teacher conducted her class. Not only teachers would broadcast their class lectures, but the services of many great men and women, worthy of leading America's child population, could then be afforded as part of the public school training. The cost of such an educational service would be small to each school.

"We have motion picture programs every two weeks, arranged by the Board of Education," continued Mr. Cox. "Now the twin to this is a radio program, broadcast during school hours so that children may hear lectures on science, civics, economics, art, music, drama, literature and health, not at home in the evening, where there are a hundred distractions, but in school, under the direction of teachers who have prepared themselves for the radio offering of the day and who are capable of discussing the subject when it is over.

"In preparation for this, I am teaching the children good radio habits—the habit of selecting only what is worth listening to and the habit of listening to the entire number, by radio as on any other occasion."

This is especially valuable in schools like the Robert Treat, where there are about fifteen nationalities, including children who, if they lived in the European countries whence their parents came, would grow up with the idea that each one had the individual right to get up in a concert hall and yell if he did not like the program, regardless of whether the other persons who purchased a ticket liked it or not.

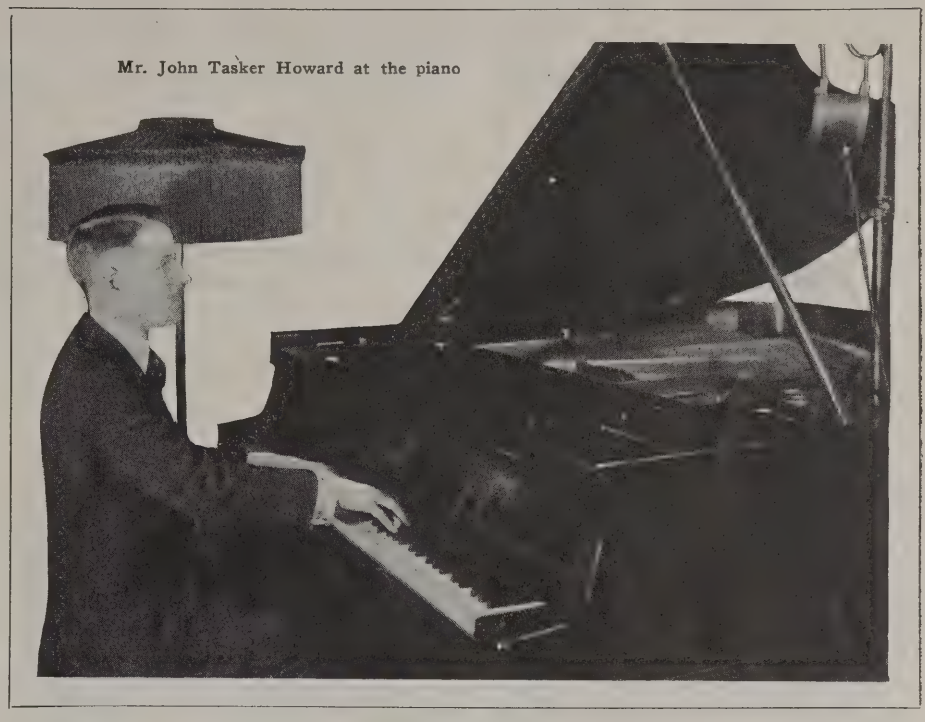
"The children are very generous," Mr. Cox reported with pride, as we entered the manual training room, where two hundred radio sets have been made by the children. "They have made a great many sets for shut-ins, who now have renewed their contact with the outside world."

The movies have given great enjoyment to the four deaf pupils at Robert Treat School, and now radio is bringing unspeakable joy to the eight blind children who are under special care. One can comprehend how tremendously the humdrum existence of the physically handicapped child has been changed by radio when one hears Arthur Vorhees, thirteen and blind, say that he likes educational lectures best and after that he enjoys hearing a good concert.

"The radio is a marvelous instrument in developing good taste," the progressive principal thinks. "It is surprising how quickly these children recognize something good when they hear it and how quickly they reject something that is not well rendered. Young critics like these will demand better artists. The radio will improve constantly, giving us better reading, better speaking, better music and better lectures."

Discrimination in Listening Homes

By John Tasker Howard



Mr. John Tasker Howard at the piano

BROADCASTING has sufficiently established itself as a public utility to allow of some intelligent speculation as to its future course. The usefulness of radio in providing late news service—weather reports, storm warnings, market fluctuations, election returns and the outcome of boxing matches — is quite obvious. Many and diverse are the opinions on radio music as an entertainment medium, however.

The year and a half of radio broadcasting has given those in charge of the stations some opportunity to judge as to what the public wants in the way of entertainment. The radio audience never hesitates to express its opinion and the radio stations receive vast quantities of daily mail in which praise or dissatisfaction is freely indulged. Frequently some enthusiastic, or it may be disgusted, auditor phones the station to express an immediate opinion.

One gentleman called to request that a certain singer be led out and treated to an application of the fire hose.

All of which shows that the public is vitally interested in its radio menu, and as long as it praises, or blames, in such unmistakable terms, it is quite evident that this interest is increasing rather than diminishing.

In my experience as director of the Ampico Series of Distinguished Artists' Concerts, held each week at WJZ, I have had some interesting sidelights, not only as to the artists' viewpoint, but also on the public reaction to these concerts.

I have found that it is by no means the artist with the greatest reputation who receives the largest amount of mail after a radio concert, and I feel perfectly safe in saying that the radio audience is more interested in how the singer sings, than in who he is.

A certain violinist, almost unknown to the general public, played his first concert at a broadcasting station, and he played beautifully. Two days later the station received large quantities of mail from all parts of the country praising the performance.

A short while afterward an artist of far greater reputation performed at the same station but being somewhat indisposed he did not play as well as usual. He received a mere handful of letters.

That the public is more interested in the performance than in the performer, is readily proved by the immediate response of the invisible audience to anything novel, or out of the beaten path. The radio fan never hesitates to remark on anything in which he is especially interested, or which makes a particularly individual appeal to him.

At one of the Ampico series of concerts a soprano rendered a brief program devoted largely to seldom-heard French songs. The affair had been announced merely as a song recital and none of the newspapers carried announcements as to what the individual program numbers would be.

The singer received letters from French people, not alone in this country, but from a large number of French Canadians.

These people had heard the songs they loved, sung in their own language, and each had felt an individual message in the performance. Each one of these individuals is eagerly awaiting this soprano's appearance in his own city or town, and if she should later tour among the localities from which she received these commendatory letters, she will surely find several enthusiastic advance agents among the French people of each place.

Another case is that of a Hungarian soprano who rendered a miscellaneous program which contained one Hungarian folk song given in her native language.

This song was rewarded with hundreds of letters from Hungarians, who said that they had not heard it since they left Hungary, and begged her to give a radio recital devoted entirely to Hungarian folk songs.

This request performance, which was given, brought an equally large number of letters thanking the singer for her ready response.

It is evident, therefore, that the public interest in radio is becoming highly discriminating. Those who listen in do so critically, and, denied the opportunity of expressing their approval by hand clapping, or disapproval by silence, they resort to letter writing.

Radio, by bringing about a new contact between artist and audience, is performing a valuable service for both.

JOHN TASKER HOWARD

Thousands have heard radio programs presented by talented artists under the direction of Mr. Howard, who has not only persuaded scores of musicians to perform for the radio audience, but has also lectured and spoken himself. He is still a young man, but his reputation as a musician, composer, and lecturer is firmly established. For some years he was managing editor of a musical publication; his songs and piano compositions are to be found in the catalogs of the leading publishers; and he himself has held the eager attention of audiences in all parts of the country with his lectures. What he has to say here is based on his broadcasting experience, which has revealed to him that radio has reversed the usual attitude of the public, which judges the radio performance by itself, instead of by the fame of the performer. This, he considers, is one of radio's great services to the musical art.

Finding and Keeping War Secrets

How Clandestine Radio Work by French Army Helped Outwit the Germans

By Robert Lenier

The ship left me alone on the shore with my tons of contraband apparatus

THE 20th of January, 1916, the submarine chaser X——, then cruising in the North Sea, received by radio the following message in cipher:

"Extremely urgent. Please transport Monsieur Y—— to Paris for Government orders. Destination allows no delay."

The same night, at 3 o'clock in the morning, the chaser set me on shore at Dunkerque and resumed its interrupted cruise. The 21st of January, at 2 o'clock in the afternoon, I stood before the Minister of the Marine, in Paris, who told me, in general terms:

"In two hours you must be out of your uniform, and in civilian clothes, with linen and all effects necessary for a year's residence as a civilian. You will leave tonight for the port of Z——, where a boat flying a foreign flag is waiting for you and will sail immediately. Here are your secret instructions, which you will unseal in 48 hours, when at sea, and from which you will give sailing orders to the ship. I have no need to recommend to you the most careful discretion, for your life will depend on yourself alone. Good-by and bon voyage."

On February 2 I landed in a country where the temperature of Spring, the azure sky, and the balmy air contrasted agreeably with the sad horizons of the North Sea, on which I had cruised for 18 months. I had come to this lovely spot on an ingrate mission of evasion and deception.

If I debarked with a light heart, after a week of rough sailing, my baggage was not landed with the same celerity. True, for myself there was but a small valise, but for the work I had come to do there were six complete radio telegraph stations. Each one, besides the sending and receiving apparatus, included a dynamo driven by a gasoline engine, and supplied with 300 litres (80 gallons) of gasoline. In addition, there were six cases of tools and spare parts and equipment, to facilitate my clandestine work without having recourse to local resources.

In all, there were 50 cases, each weighing 400 kilogrammes (880 pounds). It was in the midst of all that equipment that I landed furtively in a strange country, of whose language and customs I knew nothing.

The ship hastened to steam away, leaving me alone on the shore, where, pensive and not a little worried, I watched its silhouette move across the setting sun.

A month later, March 1, 1916, the waves of a clandestine radio telegraph station, established in the very heart of the capital, traveled through the ether, making the first tests, during which direct communications were made with an Allied warship moored 200 miles away. For a year and a half this station communicated with Allied ships cruising within this range, which was 200 miles by day and 500 by night. The matter transmitted consisted of information, supplied by the Intelligence Service, of the departure of small sailing vessels, laden with gasoline and food for enemy submarines.

I should add, as an impartial historian, that many of these ships never returned to port, and that the radio station, whose antenna concealed itself in the eucalyptus tree of a fairyland garden, was a matter of life and death to many.

A second station was established under my direction on the hardly hospitable coast of a neutral country. This, with two other stations, calculated and transmitted the positions of enemy submarines as determined by radio goniometry.

It is common knowledge that each night the enemy U-boats communicated with their secret bases by wireless, receiving information as to the departure and courses of our merchant vessels, this data having been previously reported to Nauen by the German Intelligence Service.

Independently of the chief object for which the various stations under my care were established, they also copied certain enemy and neutral stations. These texts were retransmitted to Paris, where they were deciphered and made to reveal their information, which was often vital to the national defense.

Today, due to the progress realized in amplification, the establishment of a

PROBABLY the most thrilling, and certainly one of the most dangerous of the tasks performed by radio during the war was that of clandestine collaboration with the Secret Service in neutral and enemy countries. This chapter of radio history still has to be written; possibly it never will be more completely set before the public than it is herewith, lest secrets touching the very lives of nations be robbed of their usefulness. The present account is guarded, but loses none of its exciting quality because of the necessity for caution. It is, in fact, the most moving and authoritative account of secret radio work that has been made public. The writer is Robert Lenier, a French radio telegraph officer of wide experience, who, during the course of the war, was placed in charge of an important secret mission, part of whose work he describes. His article appeared recently in the "Radio-Revue" of Paris, from which this translation has been made by THE WIRELESS AGE.

clandestine radio station is child's play. A simple loop in a room permits reception over thousands of miles. Transmission still presents certain inconveniences if it is to be secret, but by reason of the great progress made in it also, one now would not have to surmount the great difficulties of the first years of the war.

The stations were ordinary groups of 2.5-kilowatt power, producing damped waves. Reception was by crystal, without amplification. The rapidity of my departure from France had prevented me from choosing the apparatus, which was not at all qualified for its task.

I will not expand upon the difficulties, in point of view of secrecy, that had to be surmounted in transporting and maintaining in a strange and hostile country 50 cases of prohibited material, the total weight of which was about 20 tons. Such a story, interesting though it is, is outside of the scope of this article, for I will discuss only the strictly technical side of the establishment of secret stations.

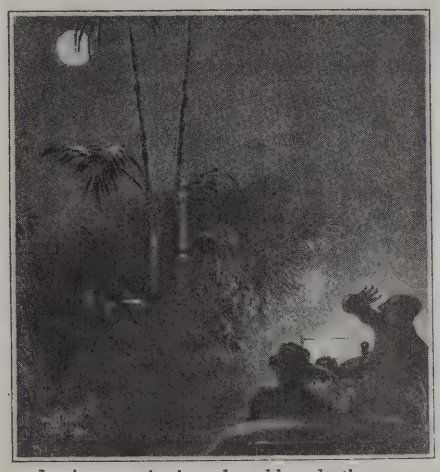
A Veiled Installation

Let us take a typical case. The station, transmitter and receiver, was established in the cellar of a house, which had been bought for the purpose, in the center of an opulent city. In spite of the pressing population, the house was surrounded by a sizable garden, which was no less necessary to the enterprise than was the house itself.

In order to muffle the noise of the damped sparks, I had had constructed a small compartment with heavy double wooden walls, the spaces between the walls being filled with sand. In addition, three woollen hangings were used, separated 10 centimeters (4 inches) one from the other. In that country, where the nights are particularly beautiful and silent, it was necessary that the sounds of transmission be absolutely silenced, so that they could not be perceived by passers-by in the neighboring streets. The dynamo-gasoline engine group, whose noise was absolutely silenced by this arrangement, however, generated an insupportable temperature in the hermetically inclosed room.

This inconvenience led me to consider the possibility of utilizing the city lighting current for transmission, but it took me a fairly long time to realize my hope. The German Embassy and its office of the Intelligence Service were both in the vicinity and were supplied from the same electric mains as our house. It could be presumed, therefore, that should this current be used for sending, all the lamps in that section of the city would flicker in time with the operation of the key, and we would, in effect, cast our messages right upon the enemy's desks. This contingency finally was avoided by confining transmission to the early morning hours, when the lighting circuit had but little drain upon it, and therefore delivered to us sufficient power for transmission without noticeable effect upon such few lamps as might be lit in the neighborhood.

A discreet receiving antenna was installed permanently. It consisted of two telephone wires, separated about two feet, which clung amorously to the house, swept grandly through the garden, meandered capriciously here and there, and finally ended in insulated darkness in a barn. This antenna was carried upon insulators of the type in current use in the city, and had every appearance of a telephone circuit. In



Intrigue, ambush and sudden death surrounded us

spite of the fact that it had a rather long stretch, its wave length was only 800 meters. Reception over it was excellent, and orders from the Eiffel Tower, on 2,000 meters, were received with a crystal detector. Transmission also was a possibility with this antenna, but its resistance was such as to cut the efficiency of the transmitter in half.

In order to secure reliable communication, and ranges in proportion to the power used, an antenna was hoisted each night in the garden. This was an inverted L, of three wires, 40 meters (130 feet) long and the vertical leg 15 meters (49 feet) in height. It was very difficult to handle, and six men were required to hoist it and stretch it through and over the trees in the darkness.

As promenaders and spies walked the nearby streets, complete silence had to be observed during the hoisting operation, which certainly did not facilitate it. As soon as transmission was ended for the night, the antenna was lowered, for during the day the garden was host to numerous visitors.

In spite of the presence of an official station only 2 kilometers (1.2 miles) from this clandestine set, it went for a long time without being discovered. If our enemies finally learned of its existence, it was from their Intelligence Service, which well knew how to profit by the slightest indiscretion, and had its agents everywhere. Technically, however, the position of this station was never exactly located.

For my work in locating secret enemy stations, I then had nothing but a simple loop and an elementary crystal receiver. Placing this in an automobile, I would ride through the country at night. Always I took the precaution of adding to the party one or two of the women of our spy service; thus the expedition had the appearance of a gallant excursion.

Thus equipped, I frequented the points where I had reason to suspect the existence of a clandestine radio station. These searches were very difficult and most deceptive, for each day the Secret Service brought me reports of the existence of such stations, reports emanating from agents more zealous than technical, whose baseless radio suspicions often led me into futile peril.

During the entire night a watch was kept for nearby transmitters, and if loud signals were heard, I would estimate the distance and direction, and then make a minute scrutiny of the suspected district. During these visits I was often obliged to employ the most diverse disguises.

Operating in this most elementary fashion, I succeeded in locating a German transmitter in the buildings of a mine formerly worked by a German company. Unfortunately, the Germans got wind of my discovery, for the following night several shots were fired from the bushes at my automobile, one of whose occupants was seriously wounded in the neck. Moreover, the station had been promptly moved. However, I found a piece of paper bearing in pencil part of a German cipher, and in the garden I discovered several trees bearing bits of antenna wire of the type characteristic to the Germans.

Constant Intrigue

All these things happened in a country whose official neutrality (???) obliged us to keep secret the nature of our activities.

It was a veritable war, as murderous and bloody as the other one that was waged in our own territory, that existed between the French and German Intelligence Services.

The least carelessness, and the moment of forgetfulness often was a death-warrant. The struggle was secret and mysterious, without mercy, without rest.

Answering "How's Business?" by Radio

Banks Use Broadcasting Stations to Transmit Market Information of All Kinds —Many Industries Finding Radio Essential for Timely Dissemination of Data

BROADCASTING usually is thought of in terms of entertainment and instruction of the general public, but that is by no means its only use. Many business houses in all parts of the country are using broadcast matter daily in a business way, and are profiting from it directly and indirectly.

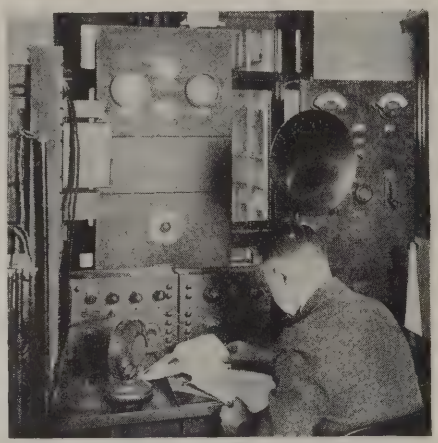
The business use of broadcasting is important, and growing steadily in volume, so that it bids fair to place the radiophone on a par with the other means of communication, advertising and publicity that are taken as a matter of course.

The most obvious use of broadcasting in business is seen in the establishment of a transmitting station by firms wishing to reach the people in their locality. The Westinghouse Electric & Mfg. Co., of course, was the pioneer in this at its Pittsburgh station, and since its first performance in November, 1920, many other companies, some of them not directly connected with the radio industry, have followed suit. Department stores form the most numerous group in this class, establishments from coast to coast having installed radio telephone transmitters. Also prominent in the operation of transmitters are various daily newspapers.

Other operators of broadcasting stations, besides radio manufacturers and dealers, include automobile dealers, music houses, schools and universities, the Y. M. C. A., oil companies, and even a church.

In nearly every case the operator of these stations expects to profit indirectly by the resulting publicity, though a store in Toronto, Canada, is quite direct, giving its call—9BA—and stating that it is ready to receive orders by radio and will send goods collect. Some of the stations co-operate with local weather bureaus and crop reporting departments of the Government in distributing their daily reports.

By far the greatest business use of the radiophone, if number of installations be considered, is through receiving instruments. Naturally, every radio apparatus store has a demonstrating set in operation, but many firms in totally foreign businesses find it profitable to listen-in daily. This is particularly true of banks in the Middle West, who need to receive crop and



Ohio farmers listen eagerly to crop reports, securities prices and weather forecasts sent through the station of the Union Trust Co., Cleveland

market reports for their own information and the benefit of their depositors. The State Bank of New Athens, New Athens, Ill., was a pioneer in this work, having installed its receiving equipment in June, 1921, in time to catch the report of the Carpentier-Dempsey fight. This attracted much attention, crowded the street in front of the bank, and aroused comment all over the State. Since then, the bank has been posting on its bulletin board the crop reports and weather bulletins received from St. Louis University. This board is consulted continually by farmers, who also telephone daily to have the news read to them.

The First National Bank, Norris City, Ill., defrayed the cost of installing a set by selling 30 "memberships" at $10 each, offering members special privileges in listening. In Indianapolis, Ind., the Bankers' Trust Co. stuck the horn of a loud speaker out of a window, and drew such crowds that the police interfered.

Other concerns that have installed receiving sets include tea rooms, restaurants, and department stores that do not care to go to the expense of installing broadcasting transmitting equipment. As has been told in these columns, a real estate operator in Philadelphia, Pa., has used the radiophone as a selling argument for his houses, advertising that each one is to be "wired for radio telephone service," so that receiving sets can be installed with the minimum of bother.

By far the most important commercial use of the radiophone is one that is increasing daily, and that is its utilization by farmers. The banks that feature their radio receiving equipment do it on the basis of the crop and weather reports they receive, and feel that in many cases the promptness of these reports as transmitted by radio has saved the cost of the instruments many times over. By saving money by radio for their depositors—and debtors—the banks strengthen their own positions as they increase the wealth of their communities by radio.

In just one case, so far as is known, was a radio receiving set tried and subsequently discarded. That was in a tea room that was of the quiet, secluded type. It installed a loud—very loud—speaker, but found it so out of keeping with the restrained atmosphere of the place that it drove away the exact type of person that it had been hoped it would attract. In radio, as in everything else, fitness counts.

Where it fits—and it seems to belong almost everywhere—radio is a surprising asset, as more and more hard-headed business men are discovering, to their sometimes great astonishment and always more or less considerable profit.

One of the most complete of the bank installations is that of the Union Trust Co., Cleveland, O., which has a radio telephone broadcasting station of 500-watt power and is transmitting financial, weather and crop reports daily. The decision to install the transmitting set was taken when it was seen that receiving sets were of great utility to banks, and in the belief that only a banking institution is equipped to gather and transmit the type of matter desired by financial organizations.

The new station transmits for two periods of 45 minutes each in the morning and afternoon, from 9 to 9.45 and 10 to 10.45 a. m., and from 2 to 2.45 and 3 to 3.45 p. m. Voice reports of major movements in the prices of stocks and bonds, latest prices on farm and dairy products, and important financial news received over the Trust Company's private wires are put on the air. In general, the new bank station supplies the entire Fourth Federal Reserve District with up-to-the-minute commercial and financial news. Once a week, from 7 to 8 in the evening, a general entertainment program is broadcast. The main purpose of the installation, however, is to serve the interests of banks and of their customers.

"Radiotherapy" in Many Hospitals

Broadcasting Offers Splendid Opportunity to Practically Every Institution—Important Use in Mount Sinai Hospital, Philadelphia

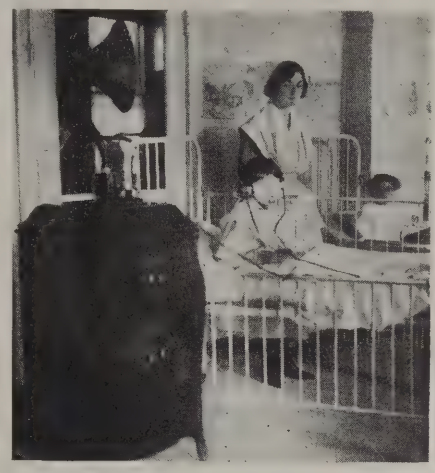
By Albert S. Hyman, M. D.
Superintendent, Mount Sinai Hospital of Philadelphia, Philadelphia, Pa.

IT has often been said that the medical profession as a whole has responded more slowly to the innovations and inventions of modern progress than any other profession; and by the same token, hospitals tend to lag behind in the adoption of the newer advancements of science. It is just as well, perhaps, that this should be so in some degree, for many hospitals can ill afford to risk hard obtained moneys upon untried ventures. Between the rejection of all things because they are new and the blind adoption of every new project, there lies a middle course which every hospital should follow if it desires to remain in the van of institutional progress.

With this in mind, it is the humble effort of this paper to discuss the place of radio equipment in hospitals; particularly those dedicated to the relief and convalescence of chronically ill patients and to those hospitals situated afar from the large centers of population. The problem of keeping such patients interested in other things besides themselves is one which hospital administrators and others have pondered for many years. Occupational therapy, systematic exercises, physiotherapy, and allied fields are essentially devices for removing the patient from himself. To these has now been added that wonder invention of the ages—the radiophone—the voice that speaks for a thousand miles, and the music that travels with the speed of light far over every hill and dale. The possibilities of the radio are yet too colossal for mortal comprehension. It is as though the great Architect of the Universe has revealed to us a little of the Unknown Beyond, where space shrinks before His will.

The radio has now reached a stage of standardization which will permit hospitals to purchase equipment without fear of radical changes and depreciation, within the next few years. Not that wireless telephony has reached its perfection, but the changes in the future will be small compared to the gigantic advances of the last five years. Similar, indeed, to the story of the gasoline motor; the great advances and changes in the construction of the internal combustion engine occurred subsequent to the first four years of the invention. The past twenty years have seen nothing but refinements of the original period of development.

During the past year, wireless telephony has rapidly standardized itself. Lending readily to popular imagination it has easily become the study of more persons, perhaps, than any other one product of pure science. The result has been a continual simplification and perfection of equipment, making it possible for a child to build for himself a receiving set capable of "listening-in" on concerts given many hundreds of miles away.



Originally, radio was installed for the children's pavilion, but it is now a necessity for the entire hospital

Simple to Operate

Standardized equipment is so simply operated that it can be intrusted to the care of the patients themselves. In expense, a radio suitable for hospital purposes costs no more than a high grade phonograph, varying in price from $150 to $225, depending on the site of the hospital buildings, the size of the antenna, and the number of accessories purchased. A two-stage amplifier set, detector, and loud-speaker are the essential parts of the equipment. If the hospital is situated within 500 miles of broadcasting stations, a single stage amplification may be sufficient.

On December 1, 1922, the government announced that there were over 600 broadcasting stations licensed in the United States. As might be anticipated, about 85 per cent were located near large cities; 63 per cent were situated on the Atlantic and Pacific seaboards. The Middle West has 21 per cent of the total number of broadcasting stations. A study of this report would seem to indicate that there were but few places in the entire country located further than 650 miles from some broadcasting station. The significance of this statement should not be lost to hospital administrators, many of whom believe that they are situated too far from any broadcasting station to make use of a radio.

Many are the ways in which the radio can actually be used in a hospital. If there are several places where the radio is desired to be heard, the entire equipment can be mounted upon a wheel carriage and connected to the antenna and ground by two leads which can be brought in through a window.

A much simpler method is to have a central control station and a mobile loud speaker. In this way it is only necessary to carry the loud speaker from room to room instead of moving the entire apparatus. In some ways this is a better method of utilizing a radio in the hospital wards as the receiving set is somewhat delicate and should not be unduly exposed to the dangers of transportation from building to building. Furthermore, it is not at the mercy of the curious and destructive. In using this method, leads are brought into the various rooms from the central control station and the loud speaker attached to these leads. At the Mount Sinai Hospital of Philadelphia, this plan has given most gratifying results. In recent experiments, we have been able to hook up the loud speaker on a single wire circuit from the control station, using a convenient nearby water pipe for a ground lead.

Can Be Used With Telephone

A third method is applicable to hospitals with far separated buildings or with isolated small cottages, such as, for example, are in use at tubercular or psychiatric institutions. The cottages must be equipped with telephone service. In the control room a loud speaker is held before the transmitter of a telephone; the switch board operator then opens keys on the lines of those wishing to listen-in. A very simple procedure, yet one which will give patients immeasureable happiness. Not far from Boston is a tubercular hospital which allows 27 cottages to listen-in at one time to concerts relayed by the control station.

Private room patients in city hospitals can also listen-in at the telephone. This can usually be done at night, as the open keys would tie up the switch board for hospital business. After 9 p. m. we have allowed certain private

patients to listen-in on their own telephones.

The field of usefulness of the radio increases daily. Originally, installed at the Mount Sinai Hospital to delight the kiddies of the children's pavilion with bed-time stories and afternoon concerts, it has gradually assumed proportions of a necessity at the hospital. Indeed, when it was silent for a few days because of storage battery difficulties, patients, staff, and visitors all expressed feelings of loss.

Radio programs have changed for the better during the past year; formerly anything musical or even tuneful was considered suitable for broadcasting, says the author, in "Hospital Management." Today, radio programs are compiled with the utmost diligence and study, for it can be truly said that "a broadcasting station can be known by the program that it sends." The best types of music, lectures, readings and reports are now the rule. It is not unusual to be able to listen-in to an entire opera rendered by the world's stars. Great men have not overlooked the vast radio audience. Harding, before his death, Coolidge and others have been heard by unbelievable numbers of persons. Only recently at the occasion of the national Pasteur centenary celebration held at Philadelphia, the speakers at a local theatre addressed nearly a half million persons.

Carries Religious Services

In addition to delighting and educating thousands, the radio has still another function which should endear it to hospital patients, and that is the carrying of religious and sacred services. From nearly every large city, church services are broadcast in their entirety; from the roll of the organ to the admonition of the preacher. The pastor must now number an unseen flock of thousands, compared to the few he actually sees. Words of consolation and of cheer do much to inspire the convalescent patient. A picture, never to be forgotten, was seen last summer when on a Sunday morn with beautiful sunshine and a gentle, fragrant breeze there knelt 159 souls who prayed in unison with a voice that came over 300 miles away; an impressive sight and surely a marvelous thing, this radio, well fitted to carry the Divine message.

There is no limit, of course, to what can be broadcast—weather reports, time signals, market and news reports, readings from good books, operas, symphonies, children's stories; all in profusion. Jazz music, too, has its way. At one isolated psychopathic hospital, far from any large city, the regular Saturday night dance is now done by radio music. No more the scratchy and antiquated dance records upon the overworked phonograph; nothing but the latest music from the jazziest band will do!

The radio has proven to be a heaven-sent blessing to the hundreds of "shut-ins" who are now able to leave their crippled and diseased bodies and fly away from their long endured imprisonment. Wireless telephony is rapidly becoming one of the essential parts of our highly complex modern civilization. Hospitals should not lag behind in the adoption of this marvelous invention, especially those situated afar and inaccessible to the regular channels of intellectual intercourse. To these hospitals the radio comes with great possibilities.

Canada Hears Fire Talks

WHAT is called the "most powerful radio receiving set in Canada" has been installed by the Canadian Marconi Company in the Forest Exhibits Car of the Canadian Forestry Association. This railroad car has just started on its 1923 tour of 15,000 miles. During this trip talks on various fire preventions and allied topics will be broadcast from the nearest Canadian broadcasting station, received by the apparatus in the car and made available to the crowds around the car by means of powerful loud speakers.

Desert Radio Saves Life

ANGUS BUCHANAN, explorer for the British Museum, thanks wireless for rendering him medical assistance while he was in the midst of the Sahara Desert. He fell while climbing the hills in the desert and was badly injured. Natives carried him fifty miles to the wireless station operated by a detachment of French soldiers. Medical advice was secured by wireless from Algiers and Buchanan responded so well to the treatment that he was able to proceed in a few days.

Ship-to-Shore Phone Service

PASSENGERS on the Admiral Liners, sailing out of San Francisco, now are able to use the ship to ship and ship to shore radio telephone. Already three of the Admiral ships have been equipped by the Radio Corporation of America with complete combination wireless telephone and telegraph sets, these being the *H. F. Alexander, Dorothy Alexander* and *Matsonia.* On May 16th, the captains and passengers of the *H. F. Alexander* and the *Dorothy Alexander* used the radio telephone to exchange messages while the two ships were at sea in the Pacific. So successful was the test that all the Admiral passenger liners are to be equipped with this apparatus and contracts for the work have been placed with the Radio Corporation. It is expected that the operators of the important passenger lines on the Pacific will follow suit.

'Change Censors Radio

IN order to guarantee that all quotations and announcements sent out by radio by members of the New York Stock Exchange shall be authentic, the Board of Governors of the Exchange has recently taken steps to regulate such use of radio. The resolution adopted by the Board is as follows:

"Resolved, That no member of the Stock Exchange or firm registered thereon shall make use of wireless or radio to transmit or broadcast market information, or forecasts of business, or financial conditions or any other matter intended to advertise such member or firm or to stimulate interest in particular securities or in the market; provided, however, that members may supply quotations to broadcasting stations which have been approved by the Committee on Quotations and Commissions at such intervals and under such regulations as are prescribed by said Committee."

Dr. Carlos Sampaio, former Mayor of Rio de Janeiro and his two daughters, Sylvia and Rosita enjoying the broadcasting of grand opera

Canada's First Radio Wedding

CANADA'S first radio wedding was consummated recently when Morris V. Chesnut, secretary-treasurer of the W. W. Grant Radio, Ltd., at Calgary, Alberta, Canada, was united in marriage to Miss Dale M. Snebley, also of Calgary, the proceedings being broadcast over CFCN from Grace Presbyterian Church, where the service was conducted by the Rev. Robert Johnston, D.D.

Bells on German Sets

MEANS for connecting a bell to a wireless telephone receiving set are reported as having been developed in Germany. When the set is properly tuned to a transmitting station, as soon as broadcasting commences a bell rings, notifying the owner that there is something to hear. He then can turn on his vacuum tubes and listen or not, as he pleases.

Mystery Radio Music

THIS is a story that can't be illustrated, because what makes it a story is the fact that there is nothing to be seen. In Jules Verne's "Twenty Thousand Leagues Under the Sea," the music room of the submarine *Nautilus* is described as being at times flooded with music from a source unseen. As the submarine is now a reality, so a room may now be mysteriously flooded with melody.

In every four-sided room each corner forms the small end of an enormous megaphone, and a person standing in the center of such a room is really standing inside the mouths of eight monster horns formed by walls, floor, and ceiling.

An ideal method of supplying music to the small ends of these horns would be by tubes of suitable size put through from other rooms, the tubes having at their outer ends radio loud-speakers connected together electrically. This, however, entails boring through the walls.

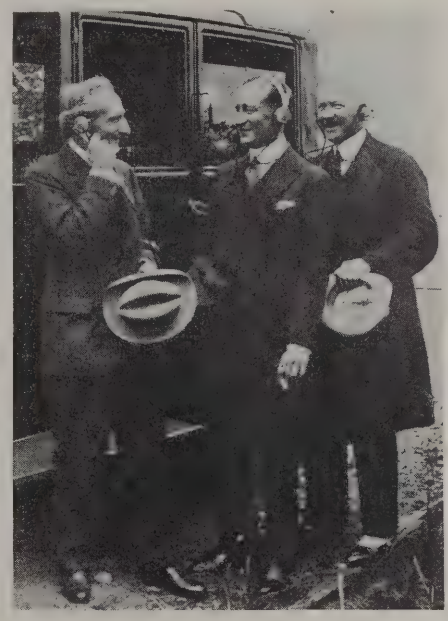
A substitute method which works beautifully is to take off the horn of the loud-speaker and attach a tube two or three inches long. This outfit is placed in a corner, the end of the tube touching both walls and floor, and inclined equally to all three surfaces; there will be plenty of air space at the tube end. The whole may be hidden from view in such a way as not to cut off the sound, as by a chair or waste-basket.

A room may thus be flooded with music, mysterious as to source, and rounded out by the balanced reflection of the sound from walls and floor.

Stop Thief!

RECOVERY of stolen automobiles by radio, once so successful, now is in dire straits. Indications are that broadcasting of descriptions of missing cars will stop. The trouble is that after the description is poured into the ears of the eager world, it is almost impossible to find the car because of the crowd of radio fans who surround it, each claiming the reward.

Station WLAG is the guilty one. It transmitted an offer of a reward of $25 for a stolen Ford; Mr. and Mrs. Evarts of St. Paul, Minn., said, simultaneously, "Why, that's the car that's been parked in front of our house for the last two hours." And all their neighbors said, also simultaneously, "Why, that's the car that's been standing in front of the Evarts' for the last two hours."



Marconi (center) listens in to the Ongar station from his motor car, on the way to Chelmsford while conducting a visiting party of a hundred members of England's Parliament

Seven called the police, and seventy, maybe more, hastened to stand guard over the machine—and the reward. When the policeman arrived it looked more like a riot than a Ford, with "I heard it first," and "I saw it first," and "I got here first," filling the air.

The question of the reward is still unsettled.

So Much an Evening

A NEW note in the radio industry appeared a short time ago with the announcement by a Washington, D. C., radio concern that it will supply "radio entertainment by the evening" if so desired.

The firm will put a reciver in your home, supplying entertainment suitable for a "social evening," with the guarantee of success or it will not charge anything.

Next!

Radio to Aid Westward Flight of ZR-3

EARLY in November the German built Zeppelin ZR-3 will start on the long aerial journey from Germany to her American home at Lakehurst, N. J., a distance of approximately 4,200 miles. This new airship will be equipped with radio apparatus of latest German design and during the trip will be kept informed of the weather conditions she will be expected to encounter. Meteorological reports will be compiled through the cooperation of the Weather Bureau, Navy Department Shipping Board vessels and other agencies and this information will be transmitted by NAA, Arlington, Va., to a station ship in mid-Atlantic. The station ship will in turn retransmit the reports to the ZR-3 and so keep her navigators informed of the weather conditions to be expected a long distance ahead.

Toll Radio Receiving

REAL estate men in Dundee, Mich., are licking their chops in anticipation of a great boom in real estate values. The flood of settlers has not started as yet, and the town still has only about one thousand people, but they hope to make it at least 100,000 soon. The reason is that the Dundee Farmers' Telephone Co., is offering radio programs at $1.50 a month. Frank W. Graudolph, president of the company, has devised a system whereby subscribers only have to throw a switch in order to hear radio programs as picked up by a special receiving set at the central office of the telephone company. Special equipment is supplied to each home that subscribes to the radio service.

Languages by Radio

THE schools in Sheffield, England, have begun to teach foreign languages with the aid of the radio telephone. Special programs have been broadcast from a French radio station for the benefit of the Sheffield educators, the matter transmitted consisting of French prose and poetry. The students listened to the program in their school rooms. So successful was the experiment that it is hoped to secure similar co-operation with radio broadcasters in Germany, Italy and Spain, as soon as broadcasting has been sufficiently well developed in those countries. European educators now view radio as a tremendous force in the teaching of languages.

WORLD WIDE WIRELESS

Radio Soon to Link America with the Argentine and China

JAMES G. HARBORD, President of the Radio Corporation of America, has recently returned from a trip to Europe, where he attended a meeting of representatives of international radio companies.

The countries represented at this conference which convened in London were the United States, Great Britain, France and Germany, and the chief object of the sessions was to complete plans for a projected radio communication service connecting both the United States and Europe directly with South America.

"These plans," said General Harbord, "previously conceived to link the United States and European countries directly with Brazil and the Argentine were enlarged upon at the recent conference. Circuits will extend from the high power station at St. Assise, France; Nauen, Germany; and Carnarvon, Wales — direct to Buenos Aires while the other will bridge the gap between New York City and Buenos Aires through the intermediary of Radio Central, the Radio Corporation of America's station on Long Island.

"Reception in Argentina from France and the United States has already been established and the receiving apparatus has been in test operation at Buenos Aires for a number of months. A notable test of this 6,000-mile circuit occurred when the returns of the recent Firpo-Dempsey boxing contest were transmitted from the giant station at Rocky Point, Long Island, direct to the receiving station at Buenos Aires from which they were subsequently broadcast by radio telephone. Having thus accomplished reception in the Argentine," continued General Harbord, "we are now finishing the erection of a high power transmitting station at that point, which when completed, will enable us to carry on two-way communication. It is expected that the new service will be ready for commercial use some time this Fall.

"I feel that Americans generally do not appreciate the great strides we have made in radio broadcasting in this country. Certainly the initiative and enterprise which American manufacturers have shown so far have placed this country far in advance of others in this new art. And the great privilege of free broadcasting exists nowhere as we know it in the United States."

Referring to the linking of America and China by radio General Harbord said:

"This undertaking calls for the erection of five powerful stations in China, the principal one to be located at Shanghai. This station will engage in direct communication with the RCA stations at Hawaii and even San Francisco, over five thousand miles distant. Shanghai will also operate a station of lesser power for communication with similar smaller stations to be located at Pekin, Canton and Harbin, each of which cities are separated by approximately 800 miles. In this way the central station of Shanghai will have 'feeder' stations in the principal provinces, through which traffic from these several territories will be routed to the giant station at Shanghai, for transmission to the western hemisphere. Conversely, Shanghai will be the gateway through which communications from points East will pass to the Chinese interior. These stations will be operated jointly by the Federal Telegraph Company of Delaware and the Chinese Government, thus placing the project under Chinese-American administration.

"American business men will be quick to appreciate the commercial significance of this comprehensive plan; inasmuch as there is today only one cable crossing the Pacific to China. And this new, strong link of friendship cannot help but play its own important part in the cause of better understanding between these two countries, and indirectly the peoples of the world."

Work on the stations will begin this Fall, and the inauguration of service is expected during the latter part of 1925, although the plan may reach maturity before that time. Test signals will, however, span the Pacific from China well in advance of the official opening.

The increased efficiency in handling foreign mails is largely due to this radio equipment aboard the U. S. mail boat "President"

New Station in Madagascar

PENDING the establishment of a permanent radio station at Tullear Bay, Madagascar, a temporary receiving station with the call FTL has been established. This station receives on a wave length of 600 meters from 9 to 11 A. M. and 7.30 to 9.30 P. M. daily.

Government Aid for Canadian Radio

GOVERNMENT aid to the extent of $55,000 has been extended in Canada for the purpose of establishing radio stations at McMurray, at the end of the railroad in Northern Alberta, Fort Simpson, on the Mackenzie River, and Dawson, in the Yukon, according to reports just received at the Department of Commerce. The new stations will displace the land lines at present in use from McMurray northward, for which the Canadian Government has appropriated from $275,000 to $300,000 annually for the past twenty-three years.

6,550-Mile Two-Way Ship-to-Shore Work

AT 5:10 A. M., Aug. 24 last, two-way communication was maintained between KPH, the Bolinas, Cal., station of the Radio Corporation of America and the S.S. *Tahiti*, while the steamship was 6,550 miles out of San Francisco in the Pacific. A 1 k.w. I. C. W. set was used by KPH. The *Tahiti* is equipped with a 1½ k.w. spark set.

Direct Service with Holland and Italy

DIRECT radio telegraphic service between the United States and The Hague, Holland, and between the United States and Caltano, Italy, was recently established by the Radio Corporation of America. The opening of these services raises the total number of direct radio circuits radiating to European countries from New York City from six to eight and affects not only Holland and Italy, but provides more direct routes between the adjoining countries and the United States.

High Power Station in Mexico

THE General Electric Company has representatives at Caracas, Mexico, preparing for the construction of a large radio transmitting station. The station is being built by the French Wireless Telegraph Company and the total expense is estimated at 38,000,000 dinars ($402,800). On its completion the entire installation will be taken over by the state and the operating personnel will become employees of the Department of Posts and Telegraphs, the company maintaining one engineer as a technical adviser. This particular station will be the first high-power radio installation in the Balkans and will afford greatly increased facilities for the dissemination of news and the rapid dispatch of information, with the rest of the world.

Japanese Ship-to-Shore Radiophone Service

JAPANESE efforts to operate a radio-telephone service out of Kobe may have to wait until operators who can speak English as well as Japanese are secured. The service of the Japan Sea Port Radio Telephone Company has been tested thoroughly by the Columbia Pacific Shipping Company, which reports that the service was satisfactory. On account of the inability of the radio telephone company to get operators who could speak English, however, it was necessary for them to put interpreters aboard ships when officers were wanted on the air. It is expected, however, that this difficulty will be overcome when efficient English speaking Japanese operators are secured.

The U. S. Government radio station at Pago Pago, on the American-owned island of Tutuila in the Samoan group

Sweden Authorizes Broadcasting

THE Government of Sweden after much deliberation, has finally decided to permit radiophone broadcasting in that country. The transmitting stations will be built by the Government, and leased to commercial companies for operation. Receiving stations may be operated by private individuals, but Government licenses must be secured for them.

Large Radio Station in the Balkans

WORK has been started on a new 100-kilowatt radio station at Rakovica, about four kilometers from Belgrade and on a receiving station at Laudon Trench, a suburb of that city.

Radio Fog Signal on Nantucket Lightship

THE new lightship, equipped with a radio fog signal, was put into service on Nantucket Shoals, on August 24, Secretary of Commerce Hoover announced recently.

The new vessel will have the first radio fog signal, an automatic apparatus sending during fog a group of four dashes every thirty seconds, enabling vessels with radio direction finders or compasses to obtain accurate bearings from a distance of 30 miles or more in any weather, and to steer for and "make" the lightship. The light vessel will also have two other fog signals, a powerful steam whistle, and a submarine bell. A little later a submarine oscillator will be substituted for the bell. The vessel is also equipped with radio for communication purposes.

Broadcasting in Italy

RADIOPHONE broadcasting will soon be under way in Italy. An agreement has been reached between a number of Italian radio manufacturers whereby a broadcasting station is to be constructed and jointly operated. Up to the present time there has been no regular broadcasting done in Italy.

Three Broadcast Stations in Italy

THREE big broadcasting stations are to be set going in Italy in the course of a week or so—one at Turin for North Italy, one in Rome for the center and south, and a third at Palermo for Sicily and the Calabrias. Concerts, meteorological information and general news will be broadcast.

The wireless habit is only just now beginning to catch on here and moderate-priced sets are being offered for sale in some of the Rome shops.

RCA Cuts Deferred Rate to Honolulu

THE Radio Corporation of America has announced that the rate on deferred messages to Honolulu from Seattle has been cut in half. Messages filed in Seattle for Honolulu and Japan with the Western Union marked RCA are transmitted to San Francisco by wire, then turned over to the radio circuit there.

Rio de Janeiro to Have Broadcasting

A RADIO organization, known as the Radio Sociedade do Rio de Janeiro has been formed in Rio de Janeiro, and already has more than 100 members. Several influential men of the city are among the officers and directors. It is also announced that a daily broadcasting service will be inaugurated by the Praia Vermelha station.

Listening to the Broadcasting of Three Continents

By Howard Adams, Jr.

ONE afternoon in 1916 I was listening in when all of a sudden I received the thrill of my life. A man's voice was there in the receivers and as loud as a regular line telephone! At first I thought some one had played a joke on me by connecting the telepone to my set, but after listening for a few seconds I was sure it was coming from the air, because it said, "This is voice number one speaking at the Washington Navy Yard. We would like to receive reports on this radio test." I immediately flew to the telephone and called the Navy Yard up to tell them I had received the phone test on my little crystal set. I reckon the man thought I was crazy because I was so excited I couldn't talk straight. Anyway he thanked me and I went out to tell the school that I had heard a voice come through the air the great distance of five miles! Little did I think then that in the year 1923 I was to hear Rio de Janeiro, Brazil, which is one thousand times that far.

The next year I bought a vacuum tube and hooked it up in an ultraudion circuit as a detector. This was a large improvement over my other detector because it didn't need adjusting all the time and as it was not regenerative the signals were practically the same as before in regard to volume.

With this single tube set I could hear the experimental radiophone at Annapolis, Md. (NSS.) At this time he was transmitting phonograph music about two or three times a week and it was with great interest that I looked forward to the days when he was on the air.

The following summer Dempsey and Carpentier were to fight for the heavyweight championship of the world and it was to be broadcast by WJY. I was then living in Baltimore, as school had stopped. Well, as soon as I knew that the fight was to be broadcast I counted my money and found I had enough to make myself a single stage of audio-frequency amplification. I wanted to be as sure as possible that I would be able to pick up the fight, so I bought the necessary apparatus for a one-step and hooked it up. It worked great and when the fight was finally broadcast I received the whole of it through heavy static.

I thought I now had the best set obtainable, just imagine hearing all the way from the upper part of New Jersey to Baltimore! Why it had my first five miles beaten by a long shot.

That fall I met a friend of mine who had just purchased a Paragon RA-10 with detector and two-step. I was so pleased with the performance of this regenerative set that I decided to junk my old one and order a Paragon. I have been getting excellent results with it as the list of stations heard clearly shows and I attribute it all to the Paragon which has proven to be a highly sensitive as well as a selective receiver. Last fall I bought a Paragon detector and two-step unit to go with my RA-10.

About the first of this year I moved to my present location in West Virginia. At first I was very busy unpacking and getting settled so I didn't have a chance to get my set in operation for about four days. Finally I did manage to hook it up, but I just could not find the time to put up a good antenna.

My room is on the third floor so I thought that I might be high enough to use an indoor antenna, even though I had no radio frequency amplification. I had brought some bell wire with me and I decided I might use this by stringing it around the top of the room. I suppose it was about seventy-five feet in all. I next made a temporary ground by clamping a wire to the gas pipe in my room. The first station I tuned in was WOC at Davenport, "Where the West begins." I considered this very good as the aerial wire was insulated only by the cotton insulation on the wire itself. I received in all about fifty stations with this aerial which ranged from PWX at Havana, Cuba, to CFCA in Toronto, Canada, and as far west as KZN, Salt Lake City, Utah. I soon began to want to try a good aerial so I decided to put one up the first chance I got.

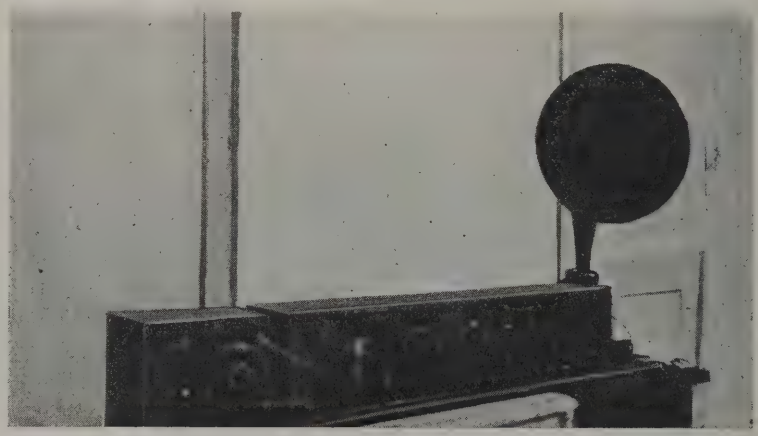
When I did put the antenna up I ran a single wire from one corner of the roof of the house to the opposite corner on a barn. This made it point northwest by southeast, and my lead-in had to come from the highest end and run down the edge of the roof.

My next thought was my ground connection. Up to this time I had been using, with very good results, the gas pipe because no water pipe was available. I decided to continue to use this pipe and also the tin roof, so after soldering all the connections I tried it out and the stations just hummed in. I was so pleased with the results I got in the next few weeks that I finally decided to send my list to THE WIRELESS AGE so that it might be published in the list of stations heard and this list is also included in this article.

I have since added the Paragon one-step of tuned radio-frequency amplification to my set. With this radio-frequency I am able to do nearly as well in the summer as I could in the winter when I had no radio-frequency.

My Paragon is like all other Paragons and I believe that anyone with such a set, well installed, can do just as well as I have. Of course, it is necessary to be careful when tuning in distant stations. You can't expect to hear California or Honolulu just by swinging the dials around, you have to move them slowly and get all the circuits well balanced and in resonance before such distant stations are audible, but after a little practice in tuning there will be no trouble at all in bringing in distant stations.

As nearly everyone knows, some localities are so situated that it is practically impossible to receive stations over fifteen hundred miles no matter how good a receiver you may own. One of these so-called "dead spots" surrounds Baltimore (Md.) and that is why the stations in that city are never heard at any distance. It is true that there are no powerful stations there, but the ones which are there should be able to send much farther than they do. Reception is also hampered by this peculiar condition and I never knew what long distance reception really was until I came out here to West Virginia.



Receiving equipment of Howard Adams, Jr., consisting of one step of tuned radio frequency amplification, Paragon tuner, detector and two steps of audio frequency amplification. With this equipment Mr. Adams has listened to the broadcasting of three continents

The following broadcasting stations have been heard by Mr. Adams on his Paragon equipment.

Station Call	Location	Distance in Miles
WHAS	Louisville, Ky.	300
KYW	Chicago, Ill.	425
WMC	Memphis, Tenn.	600
WSB	Atlanta, Ga.	450
WWJ	Detroit, Mich.	250
WGM	Atlanta, Ga.	600
WDPA	Chicago, Ill.	425
WJZ	Newark, N. J.	350
WJZ	New York, N. Y.	350
WOR	Newark, N. J.	350
WIP	Philadelphia, Pa.	300
KSD	St. Louis, Mo.	550
WOC	Davenport, Ia.	575
WDAF	Kansas City, Mo.	775
WEAF	New York, N. Y.	350
WGR	Buffalo, N. Y.	275
WLW	Cincinnati, O.	225
WLK	Indianapolis, Ind.	300
NAA	Arlington, Va.	175
WGY	Schenectady, N. Y.	425
WHAZ	Troy, N. Y.	425
WHA	Madison, Wis.	550
WBZ	Springfield, Mass.	450
CKAC	Montreal, Canada	575
KOA	Denver, Colo.	1,325
WKY	Oklahoma City, Okla.	1,025
WGI	Medford Hillside, Mass.	550
CFCN	Calgary, Canada	2,000
WDAL	Jacksonville, Fla.	625

WGAL	Lancaster, Pa.	225
WEAV	Rushville, Neb.	1,200
WCAL	Northfield, Minn.	775
KFAF	Denver, Colo.	1,325
KDYX	HONOLULU, T. H.	4,600
WGF	Des Moines, Ia.	725
WHAH	Joplin, Mo.	700
CHXC	Ottawa, Canada	500
KOP	Detroit, Mich.	250
WAAC	New Orleans, La.	875
WDAK	Hartford, Conn.	425
WCAY	Milwaukee, Wis.	485
WDAR	Philadelphia, Pa.	300
KGG	Portland, Ore.	2,250
WJY	New York, N. Y.	350
WMAC	Cazenovia, N. Y.	350
KGW	Portland, Ore.	2,250
KPO	San Francisco, Cal.	2,350
WLAY	FAIRBANKS, ALASKA	3,500
KLB	Pasadena, Cal.	2,175
KFBV	Colorado Springs, Colo.	1,325
WWI	Dearborn, Mich.	275
WNAC	Boston, Mass.	525
WBAP	Fort Worth, Tex.	1,075
WMAQ	Chicago, Ill.	425
WJAX	Cleveland, Ohio	175
WEAR	Baltimore, Md.	200
WEAM	North Plainfield, N. J.	275
WBAD	Minneapolis, Minn.	775
WLAG	Minneapolis, Minn.	775
WHB	Kansas City, Mo.	775
WOS	Jefferson City, Mo.	650
WLB-	Minneapolis, Minn.	775
WIAO	Milwaukee, Wis.	485
2XB	New York, N. Y.	350
WHAM	Rochester, N. Y.	300
WDAJ	College Park, Ga.	475
WSY	Birmingham, Ala.	550
CHYC	Montreal, Canada	575
WSM	Norfolk, Va.	275
WIAR	Paducah, Ky.	500
WBAV	Columbus, Ohio	150
WOAT	Wilmington, Del.	250
WMU	Washington, D. C.	175
WWX	Washington, D. C.	175
WJH	Washington, D. C.	175
KGU	HONOLULU, T. H.	4,600
WJAN	Peoria, Ill.	510
WHX	Des Moines, Ia.	725
WMAF	Dartmouth, Mass.	500
WHAL	Lansing, Mich.	325
WRAO	St. Louis, Mo.	550
WCK	St. Louis, Mo.	550
KDYS	Great Falls, Mont.	1,675
WOAW	Omaha, Neb.	850
WHK	Cleveland, Ohio	175
WOH	Indianapolis, Ind.	310
WHN	Ridgewood, N. Y.	350
WEAO	Columbus, Ohio	150
WGL	Philadelphia, Pa.	300
WWAD	Philadelphia, Pa.	300
WEAN	Providence, R. I.	510
WJAR	Providence, R. I.	510
WCAR	San Antonio, Tex.	1,275
KZN	Salt Lake City, Utah	1,675
SPC	RIO DE JANEIRO, BRAZIL	5,000
CHCF	Winnipeg, Canada	1,150
WBAN	Paterson, N. J.	325
WEAS	Washington, D. C.	175
PWX	Havana, Cuba	1,400
5KW	Tuinucu, Cuba	1,400
WEAD	Atwood, Kansas	1,150
WFAA	Dallas, Tex.	1,050
WAAP	Wichita, Kansas	950
CFCA	Toronto, Canada	310
2LO	LONDON, ENGLAND	3,100
WLAZ	Warren, O.	150
WFI	Philadelphia, Pa.	300
WBT	Charlotte, N. C.	300
WOO	Philadelphia, Pa.	300
WOAI	San Antonio, Tex.	1,275
WAAH	St. Paul, Minn.	775
WCX	Detroit, Mich.	250
KWH	Los Angeles, Cal.	2,200
KFI	Los Angeles, Cal.	2,200
WOAN	Lawrenceburg, Tenn.	400
WLAK	Bellows Falls, Vt.	500
CFCF	Montreal, Canada	575
WKAQ	San Juan, Porto Rico	1,400
WJAZ	Chicago, Ill.	425
WAAM	Newark, N. J.	350
WOI	Ames, Ia.	750
CHBC	Calgary, Canada	2,000
WCAU	Philadelphia, Pa.	300
KFEC	Portland, Ore.	2,250

Radio Activities in Australia

DURING the last twelve months radio in Australia has progressed considerably in many ways. First, the restrictions placed upon amateur experimenters have been modified. The license fee has been reduced to 10 shillings per annum for each separate license (transmitting and receiving). Each applicant for a transmitting and receiving license has now to pass a satisfactory examination covering technical knowledge and operating at a speed of 12 words per minute. This examination will be waived if the applicant can satisfy the authorities as to his ability to handle his apparatus in a sensible way.

The following are the conditions upon which the amateur licenses are granted: Transmitters will be restricted to two bands of wave-lengths, one from 150 to 250 meters for all classes of transmitting stations and the other from 410 to 440 meters to be reserved for radiophones and C.W. transmitters. All stations within a radius of five miles from any commercial or defense station will be limited to 10 watts and only C.W., I.C.W. and radiophone transmitters will be permitted within this area. Outside of this area and within 50 miles from a commercial station all types of transmitters except those of the plain aerial type will be permitted, but the power will be limited to 20 watts. Any station outside this area will be licensed to use upwards to 250 watts power.

Special regulations have been made to apply to transmitting stations as follows:

No transmission is to commence without previously listening in on the wave-length which is to be used in order to ascertain whether the proposed transmission is likely to interfere with any other station which may be working.

No single transmission shall last more than ten consecutive minutes and each transmission shall be followed by a period of not less than three minutes listening in on a wave-length used for transmission. Transmission is to be confined to communications relating to the experiments in hand and intended solely for the stations actually cooperating in those experiments. General calls, news, advertisements or matter similar to that which will be transmitted from a broadcasting station are expressly forbidden.

Many applications have been received for transmitting licenses, C.W. and radiophones predominating, therefore the world will soon be hearing of the results obtained by the amateurs of this country in an untried sphere of operations. Spendid results should be obtained as demonstrated by one of our leading amateurs signaling 600 miles on 3.2 watts during daylight. Such results would indicate that the Southern Hemisphere is especially favorably located for long range signaling on low power.

Arrangements are in hand for the formation of an organization to be called the Australian Radio Relay League. The main object of the league will be to relay messages on low power and so link up Australia and perhaps the British Empire. By carrying out this work in a proper manner the amateur will not only be useful should communication by the regular telegraph lines be destroyed in any part of the continent, but as a unit of defence the services of the amateurs can be utilized. The formation of this league comes at the right time as in the future the amateur experimenter will have to turn his activities into other channels besides that of transmitting speech and music. As the results of the recent Broadcasting Conferences held in Melbourne goes to show, he will soon have to take second place as far as the transmitting of entertainment is concerned.

At the time of writing the amateurs are providing excellent entertainment every night which is enjoyed by thousands of listeners-in. Since December the growth of the number of amateur transmitters has been remarkable, for where there were only two or three there are hundreds now. Applications for receiving licenses are coming in at the rate of 1,000 to 2,000 a month with every anticipation of a big increase when official broadcasting commences in the very near future.

Recently during the month of June a series of conferences were held in Melbourne by the representatives of the various parties interested in broadcasting on a commercial basis. Various schemes were discussed and that of E. T. Fisk, Managing Director of the Amalgamated Wireless, Australia, Ltd., was deemed to be most suitable to Australian conditions. After slight amendments the proposals were forwarded to the Postmaster General, who stated that regulations would be drafted from them as recommended by the conference. Hereunder are Mr. Fisk's proposals as submitted by the conference to the minister administrating the Wireless Telegraph Act, The Hon. W. G. Gibson, M.H.R.:

A—A number of wavelengths to be allotted for broadcasting purposes. Such wavelengths to be selected in respect of their suitability for station of various powers, and their suitability for standardization of receiving apparatus, and subject to their not being required for public wireless telegraph or wireless telephone services.

B—Licenses or concessions for broadcasting stations to be granted for all available wavelengths within a given area.

C—Each broadcasting station to be licensed for transmission on one wavelength only, but transfer may be approved by statutory authority.

D—Licenses to be issued under the wireless act to the public for receivers of design approved by statutory authority and capable of receiving signals of two or more services and incapable of variation without intentional tampering.

E—Licenses on nominal fee to sell or hire receiving apparatus to be issued to bona-fide manufacturers or other traders.

F—All licenses to be renewed annually excepting in the case of broadcasting stations and trading concerns which are to be for five years.

G—Concessionaries and licensed dealers to be authorized to issue licenses to all their customers who have paid their subscription to the concessionaire.

H—Receiving licenses and renewals thereof to be withheld from all persons who do not pay the annual subscription to the broadcasting stations.

I—The Government to take effective measures to protect the industry.

J—Dealers and traders only to supply receiving equipment or parts thereof to holders of licenses.

K—Dealers and traders must collect the first year's broadcasting subscription off all receivers sold.

L—Since there will be ample room for competitive broadcasting services it is unnecessary to place any limitations on

the nature of the services provided. Each concessionnaire may decide for himself the class of service that will bring him the greatest number of subscribers. That after the publication of these regulations time be allowed in which to receive applications for broadcasting licenses; such applications to be treated on their merits.

M—Retailers to keep a record of all equipment sold, together with the name, address, and license number of purchaser, and to notify the concessionaires of any particular wavelength accordingly.

N—Any person, company or manufacturer dealing in or using wireless equipment without a license from the Government shall be subject to an adequate penalty.

O—The administration of regulations governing broadcasting to be in the hands of a board having thereon representatives of the Government, of broadcasting stations of manufacturers, of traders and the press.

The following motions were adopted by the Conference Committee:

That this conference affirms the principle of preference to Australian, British and foreign manufactured apparatus in that order on such terms as will encourage use of Australian and British manufactured apparatus and that this be the recommendation from the conference to the Minister.

That this committee realizes the necessity for protecting the principle of property in news, and we forward herewith a memorandum drawn up and submitted to us by representatives of the press.

That this committee recognizes the right of fully-qualified persons indulging in bonafide experimental work to be without any hindrance, except as prescribed in Statutory Declaration No. 169 of 1922, such right to be kept in mind in the allotment of wavelengths subject to the experimenter giving an undertaking that he will not poach on broadcasting services.

These regulations should ensure a broadcasting service that will be of maximum efficiency and usefulness to the community.

Recently tests have been successfully carried out with American amateur stations. The American signals being received in (Brisbane, Queensland), (Sydney, N. S. W.), (Melbourne, Victoria). They have also been received in New Zealand, one station reporting the logging of 89 American stations on 36 consecutive nights.

Adapting Dry Cell Tubes to the Radiola RC

By Vincent Morley

THE Radiola R.C. is a regenerative type of receiver which combines with it in the same cabinet a two-stage audio-frequency amplifier. It was designed before dry cell tubes had been developed and were commercially available. The constants of the receiver were naturally chosen for operation with the vacuum tubes then available. Even though the WD-12 tubes which are supplied with the set at present have slightly different characteristics, it is possible to use them to advantage in the R.C. set.

As the WD-12 operates on but 1.10 volts on the filament it will be necessary to substitute the 1.5-volt battery for the 6-volt storage battery which would be ordinarily used with the old type of tube. Three dry cells connected in parallel will supply the energy necessary to light the filaments of the three WD-12 tubes.

It will be found that this arrangement will give very good results provided not more than 45 volts are used on the amplifier circuit. If higher amplification is desired and more voltage applied to the plates, distortion will be experienced. This effect can be remedied by the use of a "biasing battery." The introduction of a biasing battery in the circuit is not difficult and will produce improved results. In fact the method outlined herein is applicable to any type of amplifier and will give better results with increased amplification.

As the alteration will be made in the amplifier unit, it will be necessary to remove it from the cabinet. This can be done very easily by disconnecting the bars of the binding posts on the rear of the cabinet between the two units. Then remove the four oval head nickel plated screws nearest each corner of the right hand panel. All of the battery connections must be taken off and it should then be possible to take the entire unit out of the cabinet without disturbing the other half of the apparatus.

The two rheostats which are used to control the filament current can be readily located. They will be found on the lower part of the panel, the right hand one being the detector control and the left hand one for the two amplifier tubes. This last one is the one in which we are interested. If this rheostat is carefully examined there will be found a wire which has been soldered to one of the turns in the rheostat and also to one of the terminals of the amplfying transformer. It will be necessary to remove this wire and if a soldering iron is handy, it is an easy matter to soften the solder, and remove the wire. If no soldering iron is at hand the wire should be cut off as close to the rheostat as possible with a pair of pliers.

A length of insulated wire is connected to the end of the lead which is connected to the transformer, this wire being long enough to make connections outside of the cabinet. A neat job can be made by drilling a small hole in the back of the cabinet and pushing the wire through it, leaving it long enough so that it will extend through the hole when the amplifier unit is taken out of the cabinet.

This wire which has just been added has been shown by the heavy dotted line in figure 1. It is connected to the negative end of a small battery of dry cells. This battery may be a flash light battery of three cells, or the proper number of ordinary dry cells. The essential thing is that all connections to this battery should be soldered and otherwise tight. The other end of this battery is connected to the binding post marked "A" battery, or to its equivalent, the negative side of the filament battery as shown by the heavy line in the diagram.

As the values for the "C" battery—as it is called—vary with the number of "B" batteries used, the right one can be determined from the following table.

Dry cell batteries, for filament lighting, are now used extensively with the Radiola R C receiving set

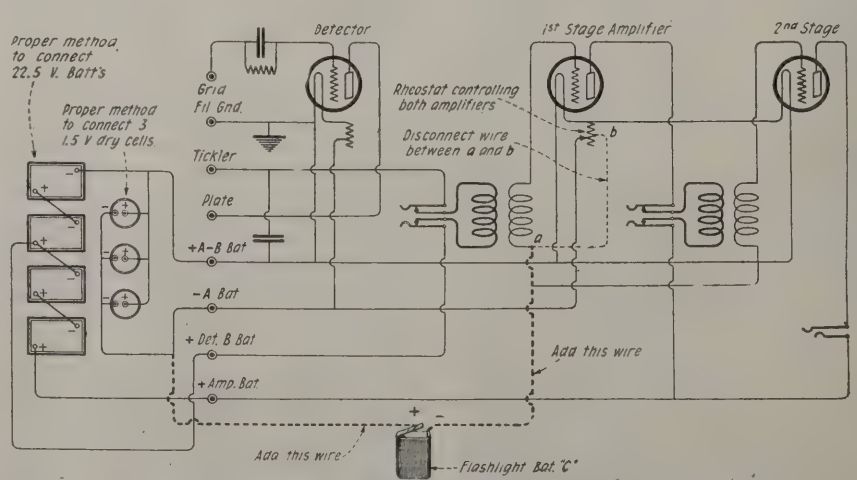


Diagram of connections of R C amplifier showing how to place biasing battery "C" so as to secure better amplification

No. 22½ Volt B Batteries	Bias Voltage	No. Cells in Series
1 (22.5 V.)	0	0
2 (45 V.)	1½	1
3 (67.5 V.)	3	2
4 (100 V.)	4½	3
5 (122.5 V.)	6	4

An examination of this biasing table would show that there is always one cell less in the bias battery than there are blocks of 22½-volt B battery. It is not advisable to use more than five blocks of 22½ volts B battery for the amplifier when WD-12 tubes are in this circuit. Although it would be possible to use a greater voltage than this there is danger of damaging the tube under such conditions. One hundred and twenty volts will be found ample enough for all amplifying purposes, including the operation of loud speaker units.

For the detector tube either 22.5 or 45 volts can be applied, some tubes working better with one voltage than with the other.

Particular care must be taken when the filament battery is connected to the set. The WD-12 tubes are designed for use with a battery giving approximately 1.5 volts. It should never be used with a battery giving more than two volts as there is great danger of burning out the filaments of the tubes.

Since there are three tubes in each set three dry cells connected in parallel should be used. This combination will give 1.5 volts and will supply about one quarter of an ampere, which has been found to be the greatest current that can be taken from a dry cell for any length of time without running it down too rapidly. If desired more cells can be connected in parallel and greater service can be had from them. In no case however should less than one cell be used with each tube.

Radio Beacons and Their Operation

By O. C. Roos

THERE are two systems in successful use today, through which a fog-bound ship, if provided with charts, can locate her position by radio signals. They are both based on the fact that a loop aerial can be made very sharply directional and responds best to signals in its own plane and least to those normal to this plane.

The navy department uses the Radio Compass system which presupposes a transmitting set on the ship. The Bureau of Commerce has developed the Radio Beacon system which does not require this. The latter system is rapidly coming into vogue on the Great Lakes and the Pacific Coast, while navy wireless stations use the former near N. Y. City and other Atlantic ports.

The Radio Compass System is operated by means of from 3 to 5 radio compass stations on shore which find the ships' directions from the stations and where these "directions" cross is located the position of the ship on a chart. The navigator does no work except to send out a code signal on 800 meters asking for bearings. These are broadcast to him in code by the principal compass station. The only trouble with this system is that it takes longer to use than the Radio Beacon system.

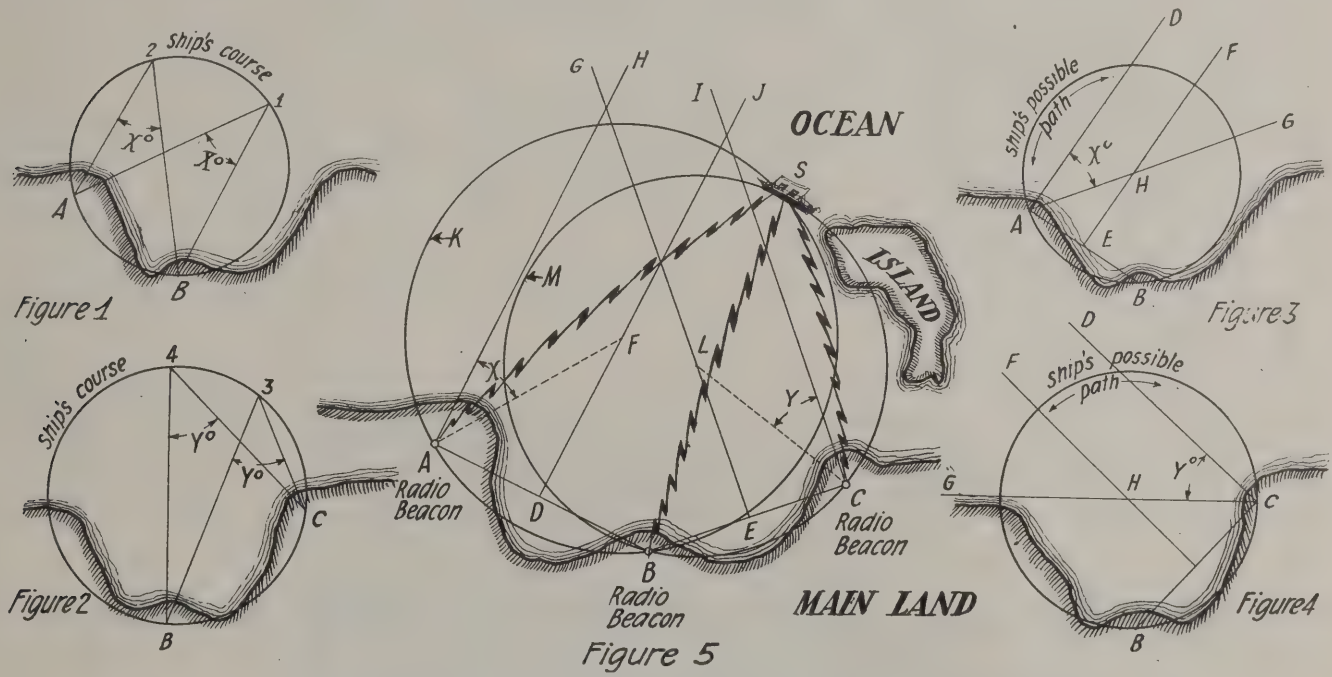
In the latter we have three radio compasses—or just one, if economy is an object—which receives signals continuously from at least three radio beacons on shore. A radio beacon is a station which radiates a continuous stream of electric waves and its direction can be quickly ascertained by a single loop aerial on a ship if it has a characteristic signal or frequency. When the loop is at right angles to this direction, the signals are weakest and this fact is more sharply indicated in turning the loop than is the condition of greatest intensity. Hence the minimum value of signal is the means used for getting the radio beacon's direction.

There are certain difficulties in using the radio beacon system when a storm rapidly changes the "course" or direction of the ship's head. It is obvious that no direction of a beacon means anything in the above system unless referred to an invariable direction—say the magnetic north. Now a storm changes this bearing of the radio beacon several times in the course of a few minutes and hence we are faced by the necessity of making all our measurements very quickly. This can best be done by using several loop radio compasses on one vertical shaft or else by arranging these compasses as near as possible horizontally, without producing mutual disturbances.

An interesting innovation, first discovered by the writer as far as he is aware will be described below which permits the ship's observers to ignore the magnetic north or even the ship's direction, by taking all beacon bearings relative to the instantaneous (relatively) direction of the ship's head, even though this may be unknown, owing to unmanagability of the ship's compass in a storm. If all radio compass loops are on one shaft, even this is unnecessary, as will be now shown in detail.

To understand this, one must master the principles underlying the method which will now be explained step-by-step.

Let us imagine that in a fog a vessel is sailing in a circle without knowing it, as in figure 1, where the above circle 1-2-A-B passes through the radio beacons A and B. Now from the elementary geometry of such a circular course, it follows that at all points on the circular arc 1-2, the angle between the directions of A and B, or in other words the *difference* in their bearings is constant.



Method of locating fog-bound ships by radio beacons

Calling this angle X there would be a constant difference between the directions of radio signals from A and B and it would be impossible for the ship's crew to determine its position. Wherever they were on the circular course—so long as it would pass through A and B—the base angle X would be constant. The name, "base angle" is justified by the fact that it is the angle subtended by the "base-line" A-B between the radio beacons A and B—as "viewed" from the ship—by radio waves!

In figure 2 we have a third radio beacon C whose direction may be compared with that of B by means of radio signals received on radio compasses on the same ship. The same laws apply here to a ship steering, a circular course, which would pass through B and C. All observations on the ship give the same base angle Y between A and B, as observed from any point whatever on the course. Hence the ship could not determine its position.

We have now derived an important law, which is the basis of the quickest method of locating fog-bound ships by radio signals; as follows: All circular courses passing through two radio beacons have a constant base angle.

The next problem is this. Knowing the base angle can we draw the particular circular course which will give it for all points on itself? The solution is very simple and elegant and is shown in figure 3.

To find the course giving a constant angle X, proceed as follows: Take a chart of the part with the radio beacons located accurately and joint them by the base line A-B. Erect a perpendicular E-F at the mid-point of A and B. Erect another perpendicular A-D at the point A and measure the angle X from A-B towards E-F. Next draw the line A-G at an angle of X degrees from A-D. Where this line cuts E-F is the center of the circle whose arc, if followed by a ship, will give a constant "base angle" of X degrees.

A similar construction to get an unchanging angle of Y degrees between B-C from the ship is shown in figure 4 with the working lines lettered as in figure 3 for clearness.

We now are in a position to understand the law underlying the finding of a ship's position. It is as follows: A ship which observes a base angle between A-B of X degrees and one of Y degrees between B-C must be at the one point which is on both circular courses giving these angles respectively. In no other way could it possibly observe such angles simultaneously.

Hence by combining the methods of figure 3 and figure 4 we can ascertain the ship's position graphically in a few minutes. This is worked out in figure 5 where the ship S is supposed fog bound and dangerously close to an island toward which it is headed. Without going over the work again, it is readily seen that F is the center of the circular course which would always show X degrees between A-B from the ship, and L is the center of the circular course which would always show Y degrees from the ship, between B-C. Hence it is only at S which lies on both these courses that we can possibly find the ship.

In working out the method, there are certain refinements in the graphical process that speed up the work a great deal. For instance, the chart of the port should be mounted on a translucent or transparent base, used as a drawing board to support it. Diffused artificial light from underneath is employed to bring out the features of the chart.

Over the chart is placed thin tracing paper or cloth on which the working lines are drawn in lead, so as to be easily erased without destroying the surface, even after several graphical calculations have been made.

A further refinement consists in having two protractors which can be accurately and quickly fastened to the translucent base by suction produced through the use of cup shaped "feet."

It will be evident—if more than three radio beacons are used—that the ship will have more than one possible position indicated, through unavoidable errors. For instance, when using four radio beacons we could have three different ship's positions; using 5 we might have four different ship's positions, etc. In such cases the center of the figure is the most probable location of the ship.

The above method is evidently entirely free from any consideration of the direction of "true north" or similar considerations. All that is necessary is quick observations of the differences in the directions of radio signals of three stations taken two-by-two consecutively, using the second station for a comparison to both the first and third.

If the ship holds its course steady, as on a calm but foggy day, a single operator can read "base angles." The method only requires him to note the angles between the compass loops when signals are simultaneously a minimum as he turns the radio compass loops.

This account of the method has taken a great deal more time than is necessary in practically applying it. A skilled operator can determine the minimum signal position of a radio compass in a few seconds. If all compasses are on one shaft he has both angles X and Y in plain sight at all times. If they are placed in line horizontally over the ship's keel—their directions are all referred to the ship's fore and aft center line.

In conclusion it may be stated that by using the Radio Beacon system as developed by the Bureau of Commerce and the Federal Telegraph Co. of San Francisco—mercantile ships have been steered with blindfolded navigators through the "Golden Gate." The observations of position were taken practically continuously.

In spite of obstacles and red tape the pioneer in practical compass work—Fred A. Kolster—has finally interested important business concerns in the problem of protecting their shipping by this method for rather the usual one of referring bearings to the "north." The results are the same, however, by the use of either method, and as a matter of fact the Bureau of Navigation is heartily in approval of the method which it has installed in a score of locations.

In another five years we may reasonably expect to find hundreds of radio beacons scattered in groups of three to five among all the important harbor approaches in the U. S. The great terror of navigation has been vanquished. Fog—the wreckers' friend and the mariners' enemy, has at least been pretty well conquered.

Lighthouse Department Extending Radio Compass Service

INCLUDING light vessels already equipped with radio fog signals and those in contemplation, eleven light vessels and two light stations are to have facilities for lessening the dangers of navigation during the continuation of fog or thick weather. By means of apparatus for the sending of wireless signals of simple and well defined characteristics, the navigator of any vessel provided with a radio compass may take bearings in guiding and locating his ship, in the absence of any visible object.

A radio fog-signaling system has been recently introduced on the Blunts Reef Light Vessel, in California located at a point where the steamship *Alaska* was sunk on the reefs some time ago. The radio-transmitting apparatus on this light vessel will send a series of simple dashes for thirty seconds, after which there will be a silent interval of thirty-five seconds, during foggy or thick weather. A radio fog-signaling system is soon to be installed on the Columbia River Light Vessel, in Oregon, the wireless transmitting characteristics of this aid to navigation being a series of triple dashes for a duration of twenty seconds, with a silent interval of an equal period of time. This installation will probably be made this year.

The most outlying aid to the seafaring voyager on the Eastern Coast, the Nantucket Shoals Light Vessel, in Massachusetts, will be equipped with means by which the navigator may determine the location of a ship when foggy conditions becloud the beacon of the lighthouse or other objects visible in fair weather. This new light vessel is nearing completion and will probably be in service during the present year. Two complete fog-signaling transmitting sets will be installed on this floating aid to navigation. The fog signals will have the characteristics of four dashes of a duration of thirty seconds with twenty-five seconds of silence. The Nantucket Shoals, 40 miles off the mainland is the extreme eastern part where aid is available to passenger and cargo-laden vessels. The Lighthouse Service of the United States Department of Commerce is in receipt of numerous requests for the installation of a radio fog-signaling system on the light vessel stationed at this point.

The Boston Light Vessel stationed in

Massachusetts, and the Swiftsure Bank Light Vessel, in service in the State of Washington, are to be equipped with wireless apparatus for determining the bearings of ships. The installation on the Swiftsure Bank Light Vessel, located off the shore of Juan de Fuca, will probably be made during the latter part of 1923.

The Five Fathom Bank Light Vessel, at the entrance of the Delaware Bay, and Cape Charles Light Vessel, Virginia, will also be provided with equipment for the transmission of radio signals, the installation to be made at some time not determined as yet. The Cape Henry Light Station, Virginia, was thus equipped and placed into commission on June 1. The radio fog signals or electrical characteristics of this floating aid to navigation are two dots and a dash, according to the Morse International Code, transmitted for a period of fifteen seconds, followed by an interval of fifteen seconds of silence.

The application of the principles of radio toward the end of increasing the safety of mariners in thick weather when lights and landmarks are invisible has been practiced for some time at the following places: Ambrose Channel Light Vessel, Fire Island Light Vessel, Sea Girt (New Jersey) Light Station, Diamond Shoal Light Vessel (North Carolina), and San Francisco Light Vessel (California).

The three stations in proximity to New York City enable vessels approaching or departing from that port to locate their positions by cross bearings and to furnish convenient leading marks to approach the harbor. Each station is identified by the definite characteristics of the radio signals it transmits. Ambrose Channel sends one dash, Fire Island a group of two dashes, and Sea Girt a group of three dashes, at specified brief time intervals.

A commercial panel-type transmitting apparatus, of one kilowatt electric power, is employed for the present in sending radio fog signals from these various light vessels. An automatic motor-driven timing switch for producing the desired signal at regular intervals was designed and placed into service supplementing the transmitting apparatus. The antenna at the transmitting station does not differ from conventional types. A wave-length of 1,000 meters has been assigned for the transmission of radio fog signals. The distance covered in sending these electric characteristics varies from 30 to 100, depending to some extent on the sensitiveness of the receiving equipment.

Radio fog signals or the method of radio direction finding, developed by the Bureau of Standards and the Lighthouse Service of the United States Department of Commerce, is based on the peculiar behavior of the coil antenna, when employed for the reception of wireless signals. This particular coil is comprised of ten turns of insulated copper wire wound about a wooden frame four feet square, which may be rotated. When the plane of the coil is parallel to the direction from which wireless signals are transmitted, the strength of the signals is greatest. By revolving the coil, the intensity of the signals is reduced until a minimum is obtained. The latter condition is reached when the plane of the coil antenna arrives at a position at right angles to the line of direction from the wireless signals. This minimum point is used for navigational purposes for taking radio bearings.

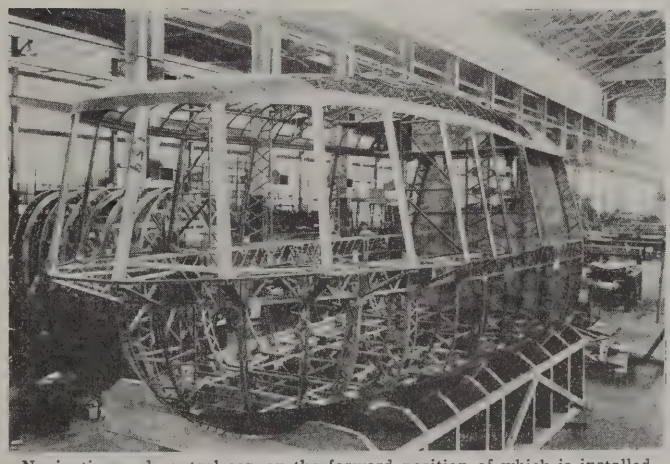
The coil antenna mounted upon a vertical spindle provided with a pointer, and a graduated circle below the pointer for determining the position of the coil, resolves itself into a radio compass or radio direction finder. The latter and essential radio-receiving apparatus are installed on light vessels as aids to navigation in thick weather. If the installation is made on lighthouse tenders, the coil is usually mounted on the roof of the pilot house. The spindle penetrates through the roof and is equipped with a wheel which is turned by hand when rotating the coil.

The installation on some large foreign vessels involves the mounting of two loop antennas in a fixed position above the upper deck, one lying in the plane of the axis of the ship, and the other perpendicular to it. The lead wires are conducted to the radio-receiving panels, where each loop is identified with a fixed coil. Two small coils are so arranged as to rotate within the fixed coils, and radio bearings are taken by rotating these until the incoming wireless signals are at a minimum strength. The reading of the direction on a fixed scale simultaneously with that of reading the ship's head by the magnetic compass enables the mariner to determine "Where am I at?" The radio-telegraph receiving apparatus on board usually consists of several stages of amplification.

Radio Equipment of the ZR-1

By S. R. Winters

THE ZR-1, the powerful airship of the United States Navy Department, at Lakehurst, New Jersey, is the first lighter-than-air craft to include a radio compass on board. This direction-finding equipment, spherical in shape, and comprised of two sets of coils, is capable of taking bearings on the range of frequencies between 500 and 30,000 meters. By use of this radio compass, this big dirigible can plot its position in the upper atmosphere and determine its course in the contemplated, but problematical, flight to the North Pole.



Navigation and control car, on the forward position of which is installed the radio apparatus of the Navy's new rigid airship ZR-1 now completed

The radio installation on the ZR-1, for the present, is confined to apparatus for the transmission and reception of wireless telegraph signals. Later, however, radio-telephone equipment will be included for the transmission of voice communication by the captain of this Goliath of aircraft when giving instructions to persons handling the lines for the bringing of the dirigible to the ground. A standard radio-telegraph transmitter of the United States Navy Department is included on the ZR-1. This transmitting equipment may be used for sending continuous and interrupted continuous electric waves by use of a rotating segment wheel. Six 50-watt electron tubes are employed, these supplying an input energy of 300 watts and an average output of 150 watts of power. The operating wave-lengths are 507, 600, 800, and 975 meters.

The antenna on this dirigible conforms to the type ordinarily used on aircraft. It consists of a trailing wire 300 feet in length and may be reeled up as the airship approaches the ground. The transmitter has been tested on the bench with a phantom type having characteristics similar to the trailing-wire antenna actually to be used. The results of these tests indicated: Fundamental wave-length, 315 meters; capacity, 300 micro-microfarads; inductance, 93 microhenries. The resistance ranges through the variable wave-lengths used from 9 to 13 ohms, giving a radiation constant of 5 amperes. A loop antenna will be accessible in the control car of the dirigible for use when the airship makes a landing.

The wireless receiving instruments for signaling on short wave-lengths are of a two-circuit type, employing six stages of amplification — three of radio-frequency, two of audio-frequency, and a detector. The six tubes are of the SE 1444 Navy type. The long-distance radio-telegraph receiver is capable of operating over a band of frequencies ranging from 500 to 30,000 meters. A universal amplifier of six stages with telephone jacks for employing either radio or audio alone in one or two stages is available.

A gasoline-driven generator, differing from the usual aircraft installation of a fan-driven generator, is the source of electric energy. A storage battery, somewhat like

(*Continued on page* 63)

Directive Radio Transmission

By Jerome Snyder

IN the July, 1923, issue of THE WIRELESS AGE the writer pointed out the importance of the question of directive radio communication and discussed the general requirements of directional transmission and reception. In this article it is proposed to consider one of the practical methods whereby directional communication is accomplished.

THE HORIZONTAL ANTENNA

One of the very first practical solutions to this problem was given by Marconi himself as far back as 1905 when he patented the idea of the horizontal antenna. He found, during the course of numerous experiments, that an antenna which had a long horizontal portion radiated more in one particular direction than in any other. Thus, figure 1 represents such an antenna, in which OA is the short vertical portion and AB the horizontal portion. Measurements made at a given distance from the antenna and in all directions of the compass around the station showed that such an antenna had a directional characteristic of the form shown in figure 2. It is seen from this that the antenna radiates most in the direction AC shown by the arrow of figure 1, while it radiates least in directions at right angles to the antenna. Thus such a transmitting antenna would radiate best in the direction directly opposite to the horizontal portion of the antenna.

In the same way he has found that if a horizontal antenna is used for reception as in figure 3, it will receive best those waves coming in the direction from C to B, while it will not receive so well in other directions. Thus if two antennas, one transmitting and one receiving, are placed back to back as it were, as in figure 4, maximum efficiency in communication will be secured. For the transmitter A radiates best in the direction of the full line arrow, namely towards the receiving antenna, while the receiving antenna receives best those waves coming from the direction shown by the dotted arrow, namely from the transmitter A.

The reason for this very peculiar behavior of the horizontal antenna has been pointed out by Zenneck to be due to the poor conductivity of the earth ground. The transmitting aerial radiates waves as shown in figure 4. These waves travel through the air, the feet of the waves gliding along the ground, while the tops of the waves travel through the atmosphere. Now if the earth and atmosphere offered exactly the same resistance to the passage of the radio waves it would follow that the top and bottom of the waves would travel along at the same speed and would arrive at the receiving aerial in the same relative position as that in which they are radiated or thrown out by the transmitting antenna. However, due to the poorer conductivity of the ground the resistance offered by the ground to the passage of the radio waves is greater than that offered by the atmosphere. Hence the feet of the waves are slowed up and the tops of the waves move forward faster than the bottom. As a result, by the time the waves reach the receiving station antenna the tops of the waves are bent forward and are almost horizontal, and therefore affect a horizontal antenna which is in the same direction as the tops of the waves, more than they affect any other antenna in any other direction. For this reason the combination of two horizontal antennas produces a very marked directional effect.

The directional effect is essentially produced by the horizontal portion of the antenna only. If the horizontal portion is very small compared to the vertical portion, there will be practically no directional effect, for the antenna is now practically a vertical antenna and a vertical antenna radiates equally well in all directions (for directional characteristics see July, 1923, issue of THE WIRELESS AGE). The greater the horizontal portion the more directional the antenna becomes.

This explains to a considerable extent why some broadcast stations seem to transmit better in certain directions than in others, and why some broadcast listeners receive some broadcast stations better than others. In general, the horizontal antenna as usually built by novices receives in all directions, but receives best in one particular direction due to the directional properties of the horizontal portion of the antenna. For this reason it is a good plan to install the antenna so that its best directional effect will be secured from the broadcasting station which it is desired to hear most. That is, install the antenna so that it is pointing directly away from the broadcasting station it is desired to hear most, figure 5. In this way the signals from this station will be the loudest, while the signals from other stations will also be good, but not so loud. In this connection it should be pointed out that a horizontal antenna of the "T" type is not as directional as one of the "L" type, for in the "T" type antenna the horizontal parts on either side of the lead-in neutralize each other's directional characteristics. Hence, if the constructor desires to obtain this directional effect, avoid the "T" aerial and build the more simple "L" antenna.

One of the very great advantages of the directional type of antenna is its inherent anti-static properties. It does not eliminate static—no antenna does at present—but it does improve the ratio of signal strength to static, which is one way of overcoming the bad effects of static. For due to the direc-

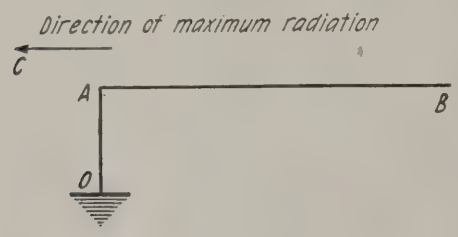


Figure 1

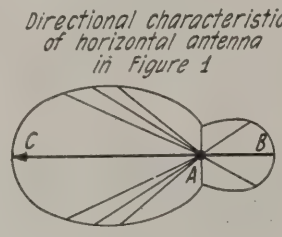


Figure 2

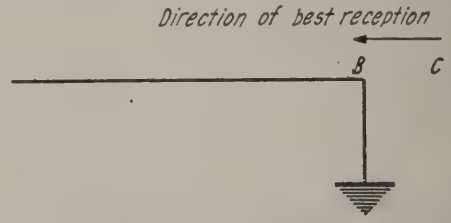


Figure 3

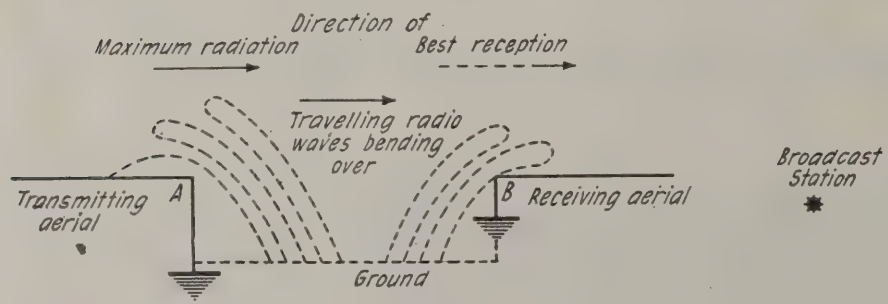


Figure 4

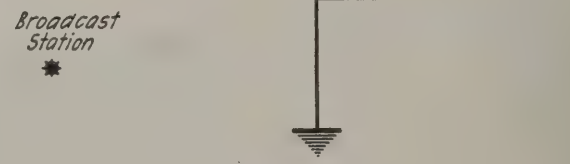
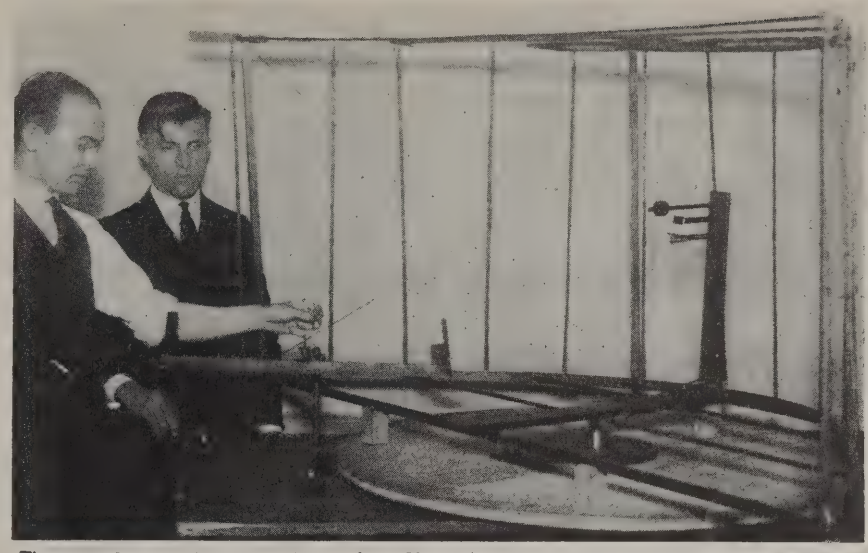


Figure 5

Some elements of directive radio telegraphy

tional characteristics of the antenna much louder signals are secured than otherwise, and likewise due to the directional characteristics the static from all directions other than the best receiving direction is reduced in intensity due to the poorer reception in these directions. Hence the net effect is that the ratio of signal strength to static strength is increase and the effect of static is reduced.

The directional effect of a long horizontal antenna is utilized in practice by the so-called "Beverage antenna," the invention of H. Beverage and other engineers of the Radio Corporation of America. This antenna consists of a very long horizontal wire, equal to the wavelength or half the wavelength to be received. It is closed at one end by the receiver and at the other end by a resistance to ground, this resistance being specially chosen to match the constants of the long antenna wire. This antenna has a very marked directional effect and reduces the static to signal ratio considerably. This was the antenna employed by Godley when he received the American amateurs' signals in England. It is fast coming into commercial use because of its great utility and effectiveness in reducing the harmful effects of static.



The most directional antenna, invented by Marconi, ever developed. All the energy is transmitted and received in the plane of the shield surrounding the transmitter or receiver

Improving the Operation of Receivers

By A. Reisner

THE big problems of the installation and operation of the receiving set of the broadcast listener generally occupy his attention to the exclusion of all other things. As a result he is apt to lose sight of the fact that many small precautions properly taken will frequently result in an improvement of reception not to be disregarded. For example, the advantage of an excellent antenna installation is to a considerable extent obliterated by using the headphones in such a manner as to demagnetize the magnets and hence receive much weaker signals than the set is capable of giving. Yet this is done day after day by novices who do not yet know that there is a right way and a wrong way to connect the headset to the receiver. A number of small precautions which will go a long way towards increasing the efficiency of reception will be given here. They are admittedly small precautions, but then small bricks are also an integral part of modern skyscrapers.

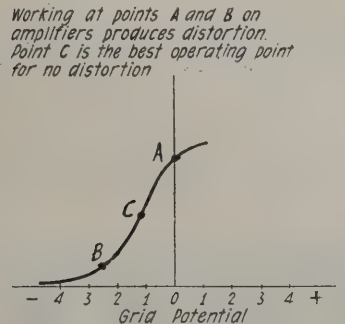

Working at points A and B on amplifiers produces distortion. Point C is the best operating point for no distortion
A
C
B
– 4 3 2 1 0 1 2 3 4 +
Grid Potential

Figure 1

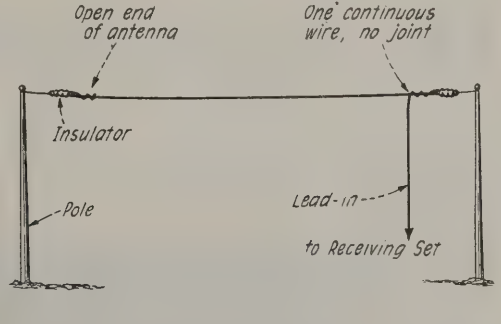


Figure 2

Diagrams showing best point for operating amplifiers and improved connection of antenna lead-in

Proper Use of Headsets

Headphones are generally connected in the plate circuit of vacuum tubes, and in this plate circuit there flows direct current. This direct current therefore also flows through the magnet windings of the receivers. Now receivers are built with permanent magnets with definite polarity. Hence it is to be expected that this polarity will be affected by the flow of current through the magnet windings. When the direct current flows in one direction through the magnet coils it produces a magnetic field which assists the permanent magnet, and when it flows through the magnet coils in the opposite direction it opposes the permanent magnet. When the current flow is such as to assist the permanent magnet, the magnets are increased in strength and the signals are thereby increased. Furthermore there is no tendency on the part of the receiver magnets to lose their magnetism and so decrease the sensitivity of the headset, for the flow of current through the magnet coils is such as to increase the magnetism of the magnets. On the other hand if the receivers are connected so that the plate current flows through the magnets so as to oppose the magnetism of the magnets, the strength of the receiver magnets decreases and the incoming signal strength is thereby weakened. Furthermore, if the current flows steadily through the magnet coils in the wrong direction the opposition results in decreasing the strength of the permanent magnets until the demagnetization has gone so far as to make the headset worthless. It is therefore of the utmost importance to connect the phones to the set in the proper manner. The best way is, of course, to follow the directions of the manufacturers. Reliable manufacturers issue instructions as to how to connect them. Generally the telephone cords have colored stripes, such as red and green, the red indicating it is to be connected to the positive side of the circuit, the other to the negative side. A very simple test is to connect the receivers one way and note what signal strength is obtained. Then reverse the phone connections and observe again the signal strength. The connection which gives maximum signal strength is the correct one for then the flow of direct current is such as to strengthen magnets and increase the signal intensity. The above precautions apply in equal measure to the connection of loud speakers to amplifiers.

Distortion and Regeneration

When music which is being broadcast is received very much distorted all of the pleasure of listening-in is lost. Distortion and poor quality is due to many causes, some of them being due directly to the broadcasting stations. The larger broadcasting stations, such as WJZ, WEAF, WOR and others send out very high grade quality, so that in such cases the distortion may generally be traced to the receiver. Too much regeneration can be easily checked by reducing it until the signal is weak and then gradually increasing regeneration. With weak regeneration the speech or music is very good, although low in intensity. As regeneration is increased signal strength increases, but a point is reached where distortion very obviously sets in, although the signal becomes very loud. High regeneration is incompatible with good quality of reception. It is for this reason that many amateurs prefer radio frequency amplification to regeneration. With regenerative receivers it is worth while sacrificing some regenerative amplification to gain in quality.

Distortion and Grid Bias

Distortion of received speech and music is very often due to improper grid bias on the amplifier tubes. Either too much or too little grid bias may produce distortion. This will be apparent from figure 1, in which is shown the characteristic curve of a standard type of amplifier tube. If no grid bias is used the tube is being operated around the point A on the curve which is not straight at that portion of the characteristic. As a result for a given rise and fall in grid voltage due to the signal the plate current varies more in one direction than in the other, thus in this case it falls more than it rises. But for true and distortionless amplification the plate current should rise and fall an equal amount for a given rise and fall of grid voltage. Since it does not do this distortion results. The same effect is produced when too much negative potential is used on the grid, in which case the amplifier is being worked at the curved portion of the characteristic marked B. For distortionless amplification the grid bias must be so adjusted that the tube is worked on the straight portion of the curve, namely at C, where a given rise and fall of grid voltage will produce an equal rise and fall of current in the plate circuit. The best way to obtain this correct bias is simply to vary the grid bias voltage until proper results are secured. Frequently this information can be secured from the manufacturers of vacuum tubes, in fact some companies like the Radio Corporation issue instructions as to how much bias should be used.

Tuning Out Interference

Many novices and at times even regular operators experience interference between broadcasting stations. Some of this interference cannot be easily overcome. On the other hand there is some that can very easily be entirely eliminated by the following simple little stunt. Connect a 0.0005 to 0.001 microfarad variable condenser across the antenna and ground post and vary it until you find a value at which one of the interfering stations disappears. After this value has been found the variable condenser may be replaced by a small fixed condenser of the same value. This plan is simple and will be found to be successful in many instances.

Increasing Wave Length of Receiver

The writer's receiver was capable of tuning up to about 450 meters. WJZ was just barely received on the maximum setting of the tuning condenser. Having a small condenser of 0.0005 microfarad capacity I tried to make use of it. I finally found that placing it directly across the antenna and ground posts of the receiver gave just the results desired. WJZ was now received about two-thirds of the way up on the tuning condenser and WEAF, which I could not get at all before, came in clearly and sharply near the end of the tuning condenser scale. At the same time this shunt condenser helped discriminate a little more sharply between various broadcasting stations, so that practically no interference at all is experienced between stations.

Eliminating Antenna Joints

It is an old story that has been repeated over and over again that in installing antennas all joints should be soldered. But since this rule is not always followed, sometimes because it is very difficult to do so, it is still a better policy to avoid the making of joints. One of the most frequent places where a joint is made is at the junction between aerial wire and lead in. To avoid a joint at this point do not cut the aerial wire when it is stretched between your two supporting points. Continue the aerial wire intact through the insulator screw eye, bring it back along itself a short way, twisting the free wire around the stretched antenna wire and then bring it down to the house, as shown in figure 2. Thus the antenna wire is continuous from the open end down to the receiver without any joints.

Saving on Vacuum Tubes

The vacuum tube in your receiver is a pretty expensive item and it is desirable to make it last as long as possible. Beginners often jack up the filament current to excessive values in order to get slightly louder signals. This means that the tube is being burned brighter than is consistent with long life. Of course if the filament current is turned down slightly the signal intensity decreases, if nothing else is done. However, the novice should try this stunt. Burn the filament as brightly as is generally done. Now turn the filament rheostat down a notch or two, decreasing the brilliancy of the filament. The signal intensity drops. Now increase the amount of regeneration either by increasing the tickler coupling or the plate variometer, or whatever other means possible, and it will be observed that your signal intensity will rise practically to the same level as before. Decrease the filament current again, and again increase tickler coupling until the signal comes up. Do this until the filament is at the lowest value consistent with reasonable signal strength. The reason it is possible to burn the filament at lower values and get just as great signal strength is this: With high filament brilliancy it is not possible to use much regeneration, because howling sets in at a very early stage, whereas with lower filament brilliancy it is possible to use greater regeneration before howling sets in. This increased regeneration increases signal strength and compensates for the lower filament brilliancy. Thus with low filament currents it is possible to secure just as great signal intensity as with high, and at the same time have the important added advantage of longer life of the tubes.

Eliminating Grating Noises in Phones

Mixed up with the incoming concert there are quite frequently grinding and grating noises which are often wrongly attributed to static. These noises will often be found to be due to poor contacts between the vacuum tube prongs and the springs of the vacuum tube sockets. Press the tube down into the socket tightly and it will be observed that the noises disappear. The remedy is to bend the socket springs up a little more so that the tube prongs press down hard on them, making perfect contact.

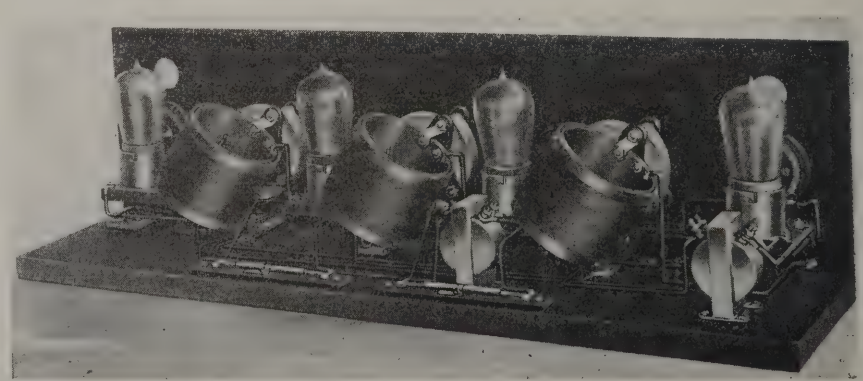
These are all small precautions which every listener ought to carefully observe. They will improve broadcast reception enormously and do away with the dissatisfaction which many broadcast listeners now experience.

How I Built My Neutrodyne Receiver

By K. S. Houton

MY radio education had advanced to the point where I could pronounce heterodyne, decrement, oscillion, and regenerative and keep company with the rest of the neighbors on my street. I really thought that there would be nights in the near future when 10 o'clock and bed-time would mean deep, peaceful sleep for me—nights when radio would be taken for granted as a settled part of our evening entertainment—and forget. I felt that my struggles to master the technical intricacies of a radio receiver so that concerts from nearby stations could soothe the fretting of three-year-old Marjorie had not been in vain. Actually, I really felt I was on the road back to normalcy—and then Professor Hazeltine came along with another tongue-twister "neutrodyne."

"Neutrodyne," I would have you know, is the name of a radio receiver circuit that is supposed to extend the sphere of the radio universe—and does, pretty well, when you get the thing to "neute."



The assembled four-tube neutrodyne receiver

Last month I had the greatest thrill in my placid life when I succeeded in picking up WIP in Philadelphia from New Rochelle on a cigar-box crystal set that cost me about $2.68 to build. Believe me, young twelve-year-old Jim Harris, the radio expert on our street, had nothing on me that night and I was ready to "tell the world."

A couple of days after that came my introduction to Mr. "Neutrodyne."

I was over to friend Harvey's house to borrow his storage battery charger—for I had graduated to the "tube" class long ago—and the moment I opened the door to his private junk-shop I was greeted by a new look of elation on George's brow and by

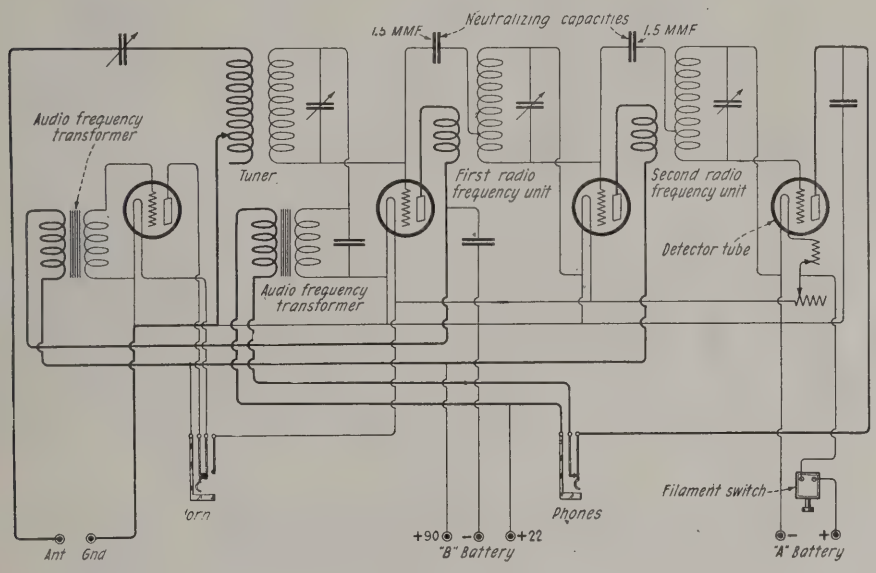


Figure 1—Schematic wiring diagram of the four-tube Neutrodyne receiver

cautions and gestures to "keep quiet while the operator is receiving."

The upshot of it all was that the new black box and his table was a neutrodyne circuit receiver, and having sat up all the past night to get Fort Worth, Texas, the malady of "long distance" had overtaken another safe and sane right good "old scout."

Of course I had to get in the swim. I let Harvey spend his perfectly good money for a factory-made instrument as I'm one of those bugs who like to realize that "grand and glorious feeling" of hearing the home-made set work after hours of sawing, drilling, mounting, soldering, wiring, testing—and Lord knows what not.

My idea was to spend about half as much and build my own—and I did. One of the worst salesmen I ever encountered succeeded in separating me from twenty-five golden dollars for which I got in return a box full of neutrodyne parts and a young encyclopedia of "How-to-Build-It" dope.

Life commenced all over again and for the next few nights the good wife had to handcuff me to my chair long enough to partake of bodily nourishment.

I was building a four-tube neutrodyne set. For the benefit of other afflicted radio bugs I'm telling my troubles, and particularly my discovered remedies.

I found among the box of purchased parts a book, in which was a full-sized paper template that I pasted down on my bakelite panel for drilling the holes. When I was ready for assembly I went all over the dope that had been published about the "Neutrodyne" and found that one of the most important things to be careful about was the mounting angle of the neutroformers. Some say about 60 degrees from the base line, some 54 degrees, and some 56 degrees. The real dope is 54.7 degrees. In adjusting the set for neutralization, however, the coils can be moved slightly from this angle until a good "no-signal" is obtained.

Another point usually in dispute is the wiring diagram. All sorts of diagrams have appeared in various publications. The four-tube diagram, accompanying this article as figure 1, is the correct one. Note particularly that the secondaries of the first and second radio frequency units have a tap in the winding. In mounting the neutroformers they should be placed on the panel to conform exactly with the wiring diagram. Connections are made from the tap of the first and second neutroformers direct to the first and second neutrodon condensers. No connection is made to the tap, however, of the first radio frequency unit or neutroformer.

The capacity values of the fixed condensers shown in the diagram are of importance. The condenser which is connected in parallel with the audio-frequency transformer secondary between the first two vacuum tubes should have a capacity of .0002 microfarads. The other two fixed condensers act as by-pass condensers and should have a capacity of at least .006 microfarads. The capacity of the by-pass condensers can be varied from the .006 point up to one or two microfarads, but .006 will usually be found O.K.

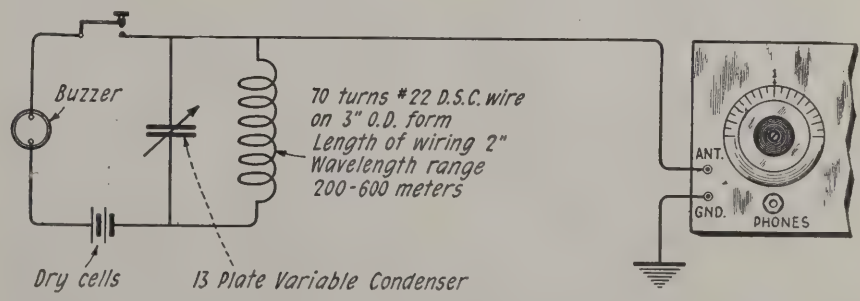
A suggestion about adjusting the neutrodyne circuit. Use a buzzer hook-up such as is shown in the adjusting diagram, figure 2. Be sure to re-tune all dials on the receiver when shifting from the adjustment of the first to the second tube. Always balance-out on a short wave-length—around 250 meters is good—or, 15 to 20 degrees on the condenser dials.

The neutrodon condensers, as will be noted, have three terminals. Ordinarily the connections are made to the two terminals on each end. Sometimes, however, one cannot seem to obtain a good minimum signal balance in this way. Then I recommend that one of the connections to the neutroformer be made to the centre terminal of the neutrodon. This gives a greater capacity range to the neutrodon and will allow added capacity adjustment to give a good minimum or inaudible signal balance.

A good test for balance is to rotate the dials as is usual in regenerative sets and attempt to pick up beat notes. If this can be done the receiver is not properly adjusted for capacity neutralization and should be carefully re-adjusted until signals come in clear and without parasitic regeneration.

Another very important point that I discovered about neutrodyne circuit receivers is the method of tuning, namely the second and third dials must be adjusted to practically the same points to receive signals from a given broadcasting station. Many people condemn the circuit after trying to tune it as they used to tune regenerative receivers. I did this very thing when I first finished my home-made set, and was ready to throw the whole thing out of the window, for results were N.G. at first. After getting the hang of things and rotating the dials very slowly and in step I began to learn anew what long distance reception really meant.

I'm using regular UV201A amplifying tubes and a UV200 detector tube in my set. These tubes work the best, but the experimenter can try other tubes, even including the various dry-cell tubes that are on the market. Be careful to check one tube against another, as much trouble has been caused by the tubes going wrong, even though the filaments remain lighted.



Circuit diagram for Neutrodyne receiver adjustment

Tests for Determining Genuineness of UV-199 Radiotrons

THE wide use and great popularity of the UV-199 Radiotron have led to numerous attempts on the part of unscrupulous manufacturers to counterfeit this tube. In external appearance some of the imitations bear such a close resemblance to the genuine tube that it is very difficult to detect the difference. Even the carton markings, the instruction sheets and the trade marks etched on the tube itself have been copied very closely.

However, in spite of the resemblance in appearance, the electrical characteristics of the counterfeit tubes are very different from those of the genuine UV-199. So far, none of the manufacturers of illegal tubes has been able to duplicate the 60 milliampere filament of the UV-199 and most of the counterfeits require as much as one-fourth of an ampere. Since this filament operates on 3.0 volts or less, the user of such a tube is often misled by the apparently satisfactory operation when the tube is first lighted, but he soon finds that his dry battery is quickly exhausted and often the tube itself fails in a few hours.

The easiest way of determining the current required by the filament is to use a milliammeter and a voltmeter, but since such instruments are not in common use among radio experimenters the following method may be used which gives a rough approximation of the filament current.

Connect three new six-inch dry cells in series with the tube to be tested and an ordinary 50-watt, 110-120 volt Mazda vacuum lamp. Figure 1 shows the proper connections. If the filament of the tube being tested does not take more than 60 milliamperes, it will light up almost to normal brilliancy, which is yellow. If the tube is not a genuine UV-199 and the filament requires appreciably more than 60 milliamperes, however, the resistance of the Mazda lamp will rise, due to the higher current flowing through it, and the voltage on the tube will be so low that its filament will not light at all. In making the test, the tube should be left in the socket for at least 30 seconds to allow the Mazda lamp filament to heat up to constant temperature.

When the proper electrical instruments are available, an even better test is to use a voltmeter and milliammeter connected exactly as shown in figure 2.

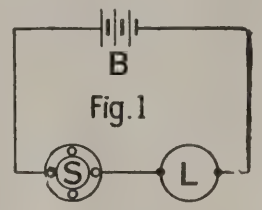


Fig. 1

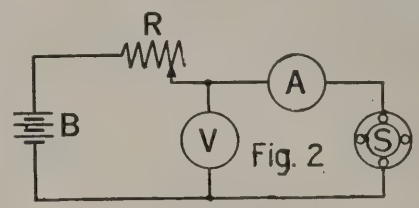


Fig. 2

Method for determining proper filament current.
B—Three new 6-inch dry cells connected in series. S—UV-199 socket. L—50-watt 110-120 volt Mazda lamp. R—30-ohm rheostat. A—Milliammeter. V—Voltmeter.

At three volts the current through the filament of a genuine UV-199 Radiotron is between 55 and 65 milliamperes. For this test high quality instruments must be used as otherwise the test is worthless. A voltmeter having a full scale reading of 5 is recommended. The milliammeter should have a full scale reading between 100 and 250 milliamperes.

Radio Antenna Design

By Frank Conrad

Assistant Chief Engineer, Westinghouse Electric and Manufacturing Company

THIS paper describes some features of antenna design, particularly when used for transmitting purposes.

The principal requirement for the transmitting antenna is that it shall transmit maximum signals with a minimum internal loss, which simply means that it shall be as efficient as possible. The ability of the transmitting antenna to radiate energy is determined by its characteristic known as "antenna resistance." Thus, in the case of some given antenna, if we determine the losses due to the conductor resistance and the dielectric losses in the capacity element of the antenna, we would find that the actual loss would be a value greater than the sum of the two losses just mentioned. This difference would consist largely of the element known as "radiation resistance," and would represent the actual proportion of the power delivered to the antenna which would be available for transmitting purposes.

Investigation has shown that the antenna resistance varies as the square of the effective height of the antenna. By the effective height we mean the actual distance between the centers of the upper and the lower capacity elements. It also varies as the square of the frequency impressed on the antenna. Of the two elements which determine the antenna radiation resistance, that of frequency, or wavelength, is easily determined.

The effective height is usually more readily obtained from measurements of the antenna resistance or signal strength a short distance away than from the physical dimensions of the antenna, unless of very simple outlines. Except as it varies with the effective height, the radiation resistance is not in any way influenced by any other characteristics of the antenna, such as its fundamental wavelength, form of conductors, or extent of upper or lower capacity elements.

We may take as an illustration a simple antenna of the inverted "L" shape connected to a conducting ground. This antenna will have a certain fundamental wavelength and certain resistances at given wavelengths. Should we add another top structure to this antenna, converting it into a "T" type, rather than the inverted "L," we will have increased the capacity element, so that the fundamental wavelength will be considerably lower. The effective height, however, will be very slightly changed and, except for this slight change of effective height, the radiation resistance at a given wavelength will be unchanged. Of course, the radiation resistance at the fundamental wavelength will be altered, due to the fact that this wavelength itself is altered. But for any given wave, in each case the radiation resistance will be unchanged except so far as the additional top structure has slightly increased the effective height.

It is usually thought that the fundamental wavelength of the antenna has some bearing on the question of the most efficient operating wave. However, investigation will show that there is no connection between the most efficient operating wave and the fundamental wave of an antenna, and that the most efficient wave is the shortest wave, omitting, of course, any consideration of the relative transmission efficiency. The efficiency of the antenna, in common with that of any other piece of apparatus, may be stated in terms of the useful output divided by the input. In general, the ratio of output to input increases with a decrease of wavelength, for the reason that in a properly-designed structure the losses will remain approximately constant with change of wavelength, while the radiation component will increase with a decrease of wavelength. Therefore, if it were merely a question of antenna efficiency, we should operate with the shortest possible wave. On the same assumption, in considering the proportions of the antenna, the losses will be very slightly changed by increased height, but the radiation element will vary as the square of the height, and, on the basis of efficiency, the antenna height should be the maximum.

I have stated before that the antenna resistance is not in any way influenced by the shape of the antenna, so long as the effective height remains unchanged, and from this it follows that it will be immaterial as to whether our antenna is of the fan shape, inverted "L," or "T" shape, as to whether its top structure is of the cage form, flat

top, umbrella shape, or what not, the radiation resistance for a given effective height will remain unchanged. However, when we consider the maximum height of any part of the antenna, the effective height, and therefore the radiation resistance, can vary widely with changes in structural shape. Thus, with an antenna consisting of a vertical wire, the effective height would be only about two-thirds of the height to the top of this wire, whereas in an antenna with a flat top of a very great extent compared with the area of the down-lead, the effective height would very nearly correspond to the actual height, and for an equal total height would, of course, show a considerably higher radiation resistance than in the case of the vertical wire.

From the viewpoint of cost, the ratio of effective height to actual height is an important one, as the elements of an antenna structure which determine its height are usually those which determine its cost. In fact, the cost will probably vary somewhat as the square of the actual height. From this, we can infer that, except under some exceptional circumstances, the plain vertical wire would not be a suitable structure for an antenna, but we should attempt to approach the ideal condition of effective height, equal to actual height, by using as large a structure as possible for our elevated capacity element, and on the same line of reasoning, we will reduce as much as possible the capacity of the vertical element of the antenna, or down-lead.

This consideration rules out the fan antenna, which has an effective height but little better than that of a single vertical wire; the amount by which it is better being determined, of course, by the relative top spread of the fan as compared with the base. Conductors of large diameters or cages for down-leads are similarly disadvantageous; and it also follows that the top structure should be of as large an area as possible and all of it maintained at the greatest possible height.

In the actual antenna, it is, however, necessary to depart more or less from these ideal conditions. Thus, there may be available one high support, such as a chimney, and to support a single flat-top element it may not be economical to erect the supporting structure for the other end of this top of the same height as the existing chimney. The question of whether the down-lead should be attached to the high or the low end of the antenna is usually determined by the local conditions surrounding the antenna, but from the consideration of effective height only, the greatest value will be obtained by attaching the down-lead to the high end.

What form the flat-top structure shall take is open to considerable variation. In general, it will be found that a rectangular shape will be the most economical form to give the desired capacity. In the case of an antenna intended for operation with long wavelengths, the problem of insulation will largely determine the capacity element; but for an antenna operated on wave lengths in the broadcasting of amateur zone, it is seldom that the question of voltage insulation will enter. The capacity element will therefore be largely determined by the value necessary to attain a reasonable effective height. The number of wires necessary for the rectangular flat-top element will be determined by its actual width, or the distance between the outside wires, and also the carrying capacity required.

With a comparatively narrow flat-top element, there is very little advantage in using more than the wires forming the outside boundary, as the increase of capacity due to additional inside wires will not be very appreciable. Thus, for a flat-top consisting of two wires spaced ten feet apart, the capacity would be about 65 per cent. of that obtained by entirely filling up the space between these wires with conducting material. With a separation of twenty feet, the capacity would be about 55 per cent. of that of a solidly-filled space. Therefore, for this spacing the number of wires might be increased with advantage. The necessary carrying capacity can, of course, be taken care of by the use of wire of sufficient size.

When considering the design of an actual antenna, it will be found necessary to make compromised departures from the ideal proportions, and a survey of existing structures would indicate that the latitude in this respect is very wide. I would say that if the antenna could be constructed on the surface of a large body of water almost any sort of design would be satisfactory, and only accurate measurements would distinguish between designs of largely different proportions. It will usually be found that the greatest source of losses is not in the antenna structure itself but in surrounding features. These losses may be due to a poorly conducting ground, dielectric losses on the surface of the ground, and induced currents in nearby conducting objects. If the location of the antenna is fixed, the designer will have very little control of these elements of losses, with the possible exception of those due to ground resistance or dielectric losses on the surface of the ground. The use of an insulated counterpoise will very largely reduce the losses from this source, as a counterpoise of the proper proportions will practically eliminate any conduction currents in the ground or any electrostatic field on the surface of the ground. The use of a counterpoise also permits of an antenna mounted on an elevated structure which can be efficiently operated at comparatively short wavelengths. Under this last condition, in which an antenna is erected on an elevated structure such as the roof of a building, it is desirable that the capacity between the antenna top and the building be practically the same as that between the counterpoise and the building; otherwise, a charge may be induced on this roof surface, which would give a circulating current between the roof surface and the ground and entail additional losses. This condition is improved by having considerable separation between the counterpoise and the roof and by using a counterpoise structure of somewhat less capacity area than that of the antenna top.

Having determined on the possible dimensions of our antenna capacity structure, we may consider the down-lead connection. There are two main possibilities here, one in which the down-lead is connected to the center of the top, forming the "T" antenna, and the other in which the down-lead is connected at one end of the top, forming the inverted "L" antenna. In the first arrangement, that of the "T" antenna, we have the equivalent of greater carrying capacity, or lower resistance, in the top structure, as the current will divide between the two halves of the "T" top. In addition, for the same capacity, the "T" top will have lower inductance and therefore permit of operation at shorter wave lengths. The disadvantage of this form is the considerable reduction of effective height due to the deflection of the top from the weight of the down-lead, for unless this deflection is allowed to be of considerable value, very heavy strain will be imposed on the end supporting the structure and insulators. For this reason, the "T" structure in general is not to be recommended.

With the inverted "L" antenna, the capacity elements can be stretched up practically flat, and the deflection due to the down-lead at one end will be very slight. However, owing to the proximity of this down-lead to the supporting structure, its capacity is more liable to be varied by swaying, and it is necessary to insure that this capacity will not be varied sufficiently to affect the wave length.

In order to obtain sufficient conductivity in the down-lead, it may be advisable to make it up of a number of parallel conductors spaced sufficiently to insure equal distribution of current. This constitutes the usual cage form. In order to reduce the capacity to a minimum, the diagram of this cage should be restricted, and it should not be necessary under any conditions to make it more than one or two inches in diameter. In general, it will be found that the actual conductor losses in an antenna are a very small part of the total. This may be readily appreciated by the fact that the resistance of a No. 14 copper wire at 300 ohms is about .02 ohm per foot. Therefore, assuming an antenna of only a single No. 14 wire and having equal current throughout its whole length, the copper resistance would be only 2 ohms, so that in an actual antenna operated at different wavelengths the equivalent of two or three wires of this size would reduce the copper resistance to a negligible value. But, of course, for the high-power, long-wave stations, such as used in trans-Atlantic service, the radiation resistance with any practical antenna height is comparatively low. Therefore, in order to obtain any reasonable efficiency, it is necessary to go to extremes in the way of reducing the conductor resistances. Fortunately, in this case the low resistance can be readily obtained by increased conductor dimensions, while in the case of our 300-meter antenna, a great decrease of resistance would be obtained only by a very disproportionate increase in conductor material, owing to the difficulty of maintaining equal distribution of current in the various sections of the conductor.

In the foregoing, no mention has been made of the question of tuning the antenna to the desired operating wave. It is not assumed that the tuning arrangement will have any effect on the radiation resistance, but, of course, in the case of operating an antenna at a wavelength below its fundamental it will be necessary to use a capacity in series with the antenna, and when operating above its fundamental wave, it will be necessary to use an inductance in series with the antenna. However, in considering the efficiency of the antenna as a whole, the losses in this capacity, or inductance, will be added to the antenna losses. But in a properly-designed apparatus, these losses should not be a con-

(*Continued on page* 63)

C.W. Work of Station 6EA

By Thomas J. Knapp

IT is not the object of this article to claim the best transmission among amateurs—others may be in a position to use a more powerful set—but many a young fellow has had trouble to acquire even a 5-watt set and may have ambitions for one of greater capacity and want to know the possibilities of its range before making further sacrifices.

The C. W. station illustrated is owned and operated by Howard C. Seefred, located at 343 South Fremont Avenue, in Los Angeles, California, call 6EA, and the results accomplished have been very gratifying to the owner.

The transmitter is of 50-watt power using about 1,300 volts on the plate supplied by a home-made transformer, which has a winding over the primary for the filament of the power tube. The plate voltage is rectified by a synchronous rectifier. No radio and audio-frequency choke coils or filter and by-pass condensers are used. The antenna plate and grid-tickler inductances are used in conjunction with variable condensers, grid leak, grid condenser, tube socket, power tube, rheostat and meters for thermo-coupler, milliampere, and volt readings, all mounted on a bakelite panel, also a radio key, using a modified reverse feed-back circuit. The antenna current is 4 to 4½ amperes, with 170 milliamperes of plate current, and 10½ volts on the filament.

The receiver is of the single circuit type and consists of three spiral wound inductances—antenna, tickler, and tickler loader—antenna variaable condenser, detector with two-stage amplifier, variable condenser to load up to six hundred meters, and Baldwin phones. The complete equipment is home-made except the necessary parts that could not be readily manufactured.

The antenna is 52 and 45 feet in height, with four wires on 16-foot spreaders, 45 feet long, with 55-foot cage lead-in.

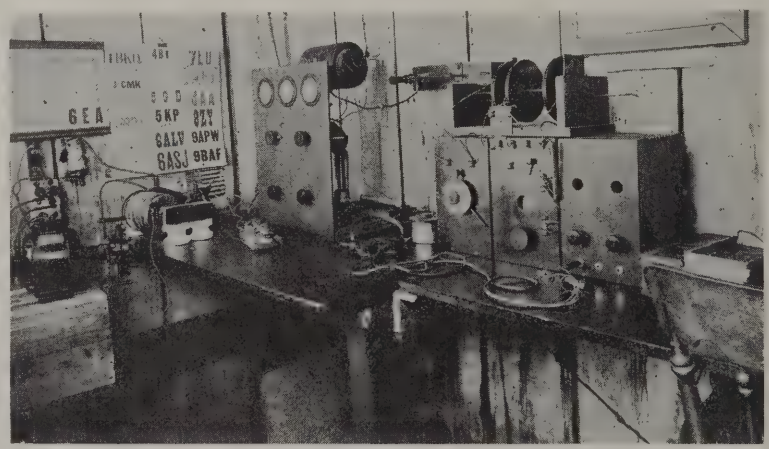
The counterpoise system has nine wires 60 feet long, 23 feet wide at the far end, 14 feet at the lead-in and at a height of 11 feet above the earth. Both antenna and counterpoise consists of seven stranded No. 22 copper wire.

Antenna system of 6EA Station, Los Angeles, Calif., an efficient radiator as determined by actual results

During the past winter of 1922-1923 this station has communicated directly with station 2FP, Brooklyn, New York, the distance being close to 3,000 miles from Los Angeles. It has been reported several times by VLB at Radio Awarua, Invercargill, New Zealand, at a distance of nearly 7,000 miles. The *S. S. Easterner* reported hearing this station when 3,060 miles west of here. Best distance to the north was a report from 7DG at Cordova, Alaska; To the east—1CIK at Concord, New Hampshire; to the south—"BX" at Guamajuato, Mexico. Best Canadian report was from 9AL at Toronto, Ontario.

The station has been heard in five Canadian districts, all United States districts and thirty-eight states, Alaska, Canada, Hawaii, Mexico and New Zealand.

When using five watts, A.C., C.W., 6EA has communicated directly with 6ZAC at Hawaii (2100 miles) and 9DR at Minneapolis, Minn. (1535 miles). The best reception reported to the east was from 8IB and 8CZN, both in Ohio and about 2100 miles distant.



C. W. transmitter of station 6EA, the novel feature of which is a synchronous rectifier for plate current supply

Enlarged Appropriations Required for Radio Inspection Service

A GREATLY increased appropriation will be asked of the next Congress for the operation of the Radio Division of the Department of Commerce, which to-day is struggling along on funds but little greater than those available three and four years ago when broadcasting, as we know it to-day, was non-existent.

If the Radio Division is to perform its functions efficiently, at least $100,000 more than is now appropriated will be necessary, it is believed. A greatly increased force of inspectors is needed if the broadcasting and amateur stations are to be checked up properly. At present, practically all of the time of inspectors, on the coast particularly, is required for the inspection of ship stations and similar Government work, and they are hard pressed for the time in which to make these necessary inspections of other stations. The recent re-allocation of wavelengths, however, requires that every station be operated exactly on its assigned wavelength, if there is to be no interference, and careful checking up of the wavelengths used is therefore very essential.

Few persons not connected with the work of the Department of Commerce realize what the district inspectors are doing. Many of them are out of bed and ready for their day's work before the last "ham" has signed off for the night. All sorts of work come to the radio inspectors; the checking of broadcasting stations and the inspection of ship plants is but a part of their labor. Many complaints are received, some well founded and some imaginary; but all must be investigated, with the general result that practically every inspector is heavily overworked, with many essential things left undone, owing to lack of time and funds.

Oberlin College Radio Station 8 YAE

RADIO Station 8YAE is located in the laboratory of physics at Oberlin College, Oberlin, Ohio. It is operated by a staff of four operators, and very consistent relay work over long distances was accomplished with the 10-watt transmitter in the center of the illustration appearing in this article.

The antenna at 8YAE consists of a six-wire flat top, 55 feet high and 75 feet long, hung between two of the college buildings. Directly beneath it at a height of 15 feet is an eight-wire counterpoise which covers an area of over 2000 square feet. It is 100 feet in length and 23 feet in width. For earth connection, the water pipes and the college heating system steam pipes are used.

The station is well equipped in the receiving line for both amateur 200-meter work and broadcast listening on the higher wavelengths. The station includes a separate receiver for each. On the left in the illustration is the single circuit receiver used for relay work. The circuit employed is similar to the Grebe CR-5. Only one stage of audio frequency amplification is used as this is found amply sufficient for all DX work, even when using the small indoor antenna for working through heavy QRN. This set is homemade and has a range of from 150 to 400 meters.

On the table to the right is the broadcast receiver. This was built in the laboratory, and is very efficient over its band of wavelengths. Either a three-circuit regenerative or a non-regenerative unit may be employed with this set. The latter in conjunction with two stages of radio frequency amplification. The last unit on the right is a Western Electric power amplifier and loud speaker.

Radio Station 8YAE, Oberlin College, Oberlin, Ohio —E. W. Thatcher, chief operator

On this equipment musical programs have been heard with remarkable clearness several hundred feet from the loud speaker.

The C.W. transmitter consists of two five-watt tubes in a Colpitts circuit. An electrolytic rectifier of twelve lead-aluminum cells delivers 500 volts to the plates. A saturated solution of borax serves as the electrolyte. A filter system consisting of two 2 mfd. condensers and a 1.5 henry choke smooths out the ripples and gives the transmitter a very pleasing note. The circuit is quite flexible, good radiation being obtained on wavelengths from 180 meters up. The set is usually operated on 220 meters with an antenna current of 1.8 to 2.0 amperes. The plate current is 105 milliamperes, and the filaments are kept at a constant voltage of 7.8. The potential for both the plates and filaments is supplied by an Acme 200-watt transformer.

This set has been in operation since the first of the year, and a great deal of traffic has been handled. Remarkable distances have been covered by this low power transmitter. Stations in all districts of the United States and Canada have been effectively worked. The best working records established were with 6XAD in Avalon, Calif., and 7SC in Aberdeen, Wash., and on many other occasions the signals were reported from the Pacific Coast.

Radiophone Aids Alaskan Lighthouse Service

IF anyone is prone to scoff at the adaptation and value of the radio telephone and telegraph in isolated territory—in regions removed from civilization, as it were —the contents of a letter recently received by the Lighthouse Service of the United States Department of Commerce should serve to dismiss this misapprehension.

Tucked away in the recesses of Alaska, the Lighthouse Service maintains light stations at points designated at Scotch Cap and Cape Sarichef as aids to mariners navigating in these waters. The keepers of these stations readily converse with each other by means of radio telephone. Since, however, vessels navigating in Alaskan waters are not ordinarily equipped with radio telephones, communication is restricted to radio telegraphy. Hence, these enterprising guardians of life and property on water began to study the Morse International Telegraph Code, attempting to master this intricate system of dots, dashes and spaces by applied practice in the absence of instruction or outside assistance.

These keepers, not unlike the student in land-line telegraphy who keeps books for the station-master while studying the Morse telegraph code, have by slow and painstaking effort acquired knowledge sufficient to manipulate the telegraph key and send code messages, slowly, of course. This incident, as well as others, in the application of radio telephony and telegraphy to the aids of navigation in Alaska, are interestingly told about in a letter recently written by W. C. Dibrell, superintendent of lighthouses of the sixteenth district, to the Washington office of the Lighthouse Service. This communication, inspiring as it is with relation to the uses of radio in remote areas, is quoted in entirety:

"The two stations converse with each other by 'phone without difficulty. Owing to lack of radiophones in that part of Alaska other business is handled mainly with key. One keeper at each station has taken up the study of the code and the manipulation of the key, and they are now able to handle key messages each way without difficulty, although they are still somewhat slow. They have no difficulty at all in exchanging messages with the mail steamer *Star* by means of the key, the vessel not being equipped with phone. Messages can be exchanged by this means when the steamer is west of Unga, or distant not more than 165 miles. When the *Star* reaches the vicinity of False Pass, distant about 65 miles, in a straight line and on the opposite side of high mountains the voice from Sarichef can be heard by the *Star*. It is reported that when the *Star* is off the stations, the voice can be heard in the radio room of the vessel without wearing the head phones. The use of this means of communication with the mail boat has been of great service both to the vessel and to the stations. Whenever the boat is approaching Unimak Pass information can be obtained direct from both stations as to landing conditions and no time is lost if landing cannot be effected. Instructions can also be issued from the station in regard to landing of mail for that station at Scotch Cap, if possible, and it is then carried overland by keepers.

"Both stations can readily converse with the radio station at Dutch Harbor by key, which means that the stations are in touch with the outside world by radio at all times which is of great value in case of emergency. The Coast Guard Cutters when in Bering Sea and vicinity converse with the stations by radio. Some of the cutters are provided with radio telephones.

"The *Cedar* has recently been provided with radio telephone and conversation can therefore be readily carried on with the Light Station when the vessel visits that location. This will undoubtedly prove of great assistance in connection with landing of supplies at the station."

Ionization in Vacuum Tubes

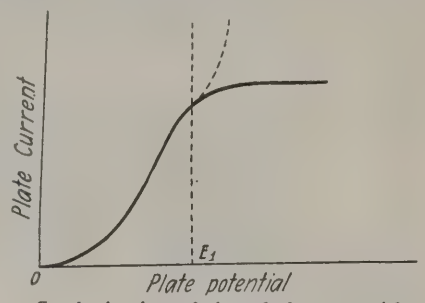
By W. A. Dickson

IT is a well known fact that some vacuum tubes are termed "hard," and others "soft," according to the extent to which they are evacuated; in other words, according to the amount of gas remaining in the tube. An ideal tube would contain no gas at all, i. e., would be evacuated to a perfect degree; this is impossible of course, and we find a varied quantity of gas in all present-day tubes.

The most deleterious effect on the presence of gas in a vacuum tube is ionization, which may be defined as the breaking-up of the normal gas atoms when subjected to too high a potential gradient; this corresponds to the "breaking-down" of any insulator. Gas is ordinarily a good insulator, but when ionized can be made to carry a large current. We will endeavor to give only an elementary idea of what happens when a tube becomes ionized.

Studying the curve in the accompanying diagram, consider the solid line curve showing the relations between the plate potential and plate current for a constant filament temperature. The higher the plate potential, the greater the velocity of the electrons flowing from the filament to the plate, especially after the saturation value of plate current has been reached. Now if the tube contains no gas, a certain potential, E_1 will be reached, for which the velocity of the electrons is great enough to break up the normal atoms of gas into two parts, namely, free electrons and positively charged ions. The positive ions travel toward the filament and the free electrons toward the plate thus producing an increased plate current. This is shown in the diagram by the dotted line curve.

If the plate of a vacuum tube is made negative with respect to the filament no current will be registered, for this would necessitate an emission of electrons from the cold



Graph showing relation of plate potential and plate current for a constant filament temperature

plate. However, if the tube contains a sufficient amount of ionized gas, this would serve as a conductor for the current. Usually the filament must reach a certain temperature before ionization starts.

Ionization in a vacuum tube can readily be distinguished by the familiar blue glow which is accompanied by an immediate increase in plate current which owing to the great change in the characteristics of the tube, will generally stop it from functioning. This blue glow may be noticed in highly evacuated tubes when operated at potentials much greater than for which the tube was designed. It is due not so much to the ionization of the gas left in the tube, as to the ionization of the gases resulting from the volatilization of the plate under the effect of the impact of the electrons against it at such a great velocity.

In the case of detecting and amplifying tubes, ionization is quite common and can be stopped by decreasing the plate voltage or filament current. However, in the case of power tubes, ionization, unless stopped immediately will leave the tube useless for further operation. In vacuum tubes with oxide-coated filaments, ionization will usually result in their burning out; this action can be explained in a few words. There is always a large amount of gas in the metal parts of this type of tube, and when ionization occurs the positive ions are attracted by the filament, causing a bombardment; this results in an extra heating of the filament generally in one spot. When the filament burns out, considerable more gas is released, which becoming ionized, may result in an explosion. Usually a vacuum tube with oxide-coated filament has more gas in it after becoming ionized than before.

Due to the effects of the presence of gas in a vacuum tube great care has to be taken during the process of evacuation.

The tubes used today for detecting purposes are usually allowed a small gas content, as it has been found that at certain points they are more sensitive.

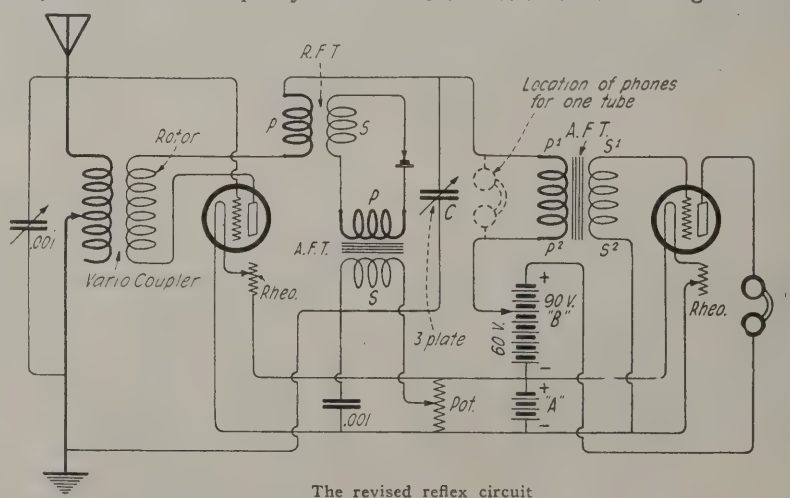
A Revised Reflex Circuit

By J. McCartney

THE very interesting article in the May, 1923, issue of THE WIRELESS AGE, headed—"A New Reflex Circuit," by Stanley Russell, led me to give it a tryout, and I beg to advise that the results were particularly satisfactory. Lacking some of the parts necessary for a trial of figure 2, of that article I experimented with figure 1, at first with a single tube, with the result that the addition of another stage worked out very satisfactorily, and gave excellent increase in volume, and was no more difficult to operate than the one-tube circuit. The variometer between the primary of the R. F. T. and the plate of the first tube actually increased the output; the only peculiarity noted being that the positive lead from the "B" battery had t go to the P-2 post of the A. F T. to get results. The circuit as revised is as follows:

The variocoupler used was of the "Simplex" variety. Some other type might need a different adjustment of values. Note that the plate circuit of the first tube passes through the rotor of the variocoupler which no doubt increases by inductive regeneration the potential of the grid.

The small three-plate or vernier type of condenser (three plate) shown as C, as I figure it, gives the radio frequency an opportunity to operate at its full value instead of being wasted by resistance in the phones, the primary of the audio frequency transformer of the second tube, or the batteries, in order to complete the circuit to the filament of the first tube.



The revised reflex circuit

There is also an adjustment relation between the position of the small three-plate condenser and the rotor of the variocoupler, dependent upon the amount of induction in the primary of the variocoupler, which is more in evidence when the greater number of turns are being used. This, of course, can be determined by the experimenter.

I should like to have Mr. Russell's comments on the modifications of his original circuit as outlined in this article.

Notes on Insulation Phenomena

By A. Reisner

THE writer has found that many electrical experimenters have some peculiar notions about the subject of insulation. These notions pertain especially to the value of using more than one dielectric or insulating medium for insulation purposes. Many of them feel that if they have air as the insulating medium between two terminals and partially fill this air space with some other insulator, for example glass, the insulation will be able to withstand a greater voltage because glass is a stronger dielectric than air. This theory is absolutely wrong as will be more evident from what follows.

Suppose we have two electrodes between which we are applying a high voltage, as in figure 1. Let us say we are applying 3,000 volts and the electrodes are spaced 10 centimeters apart. Now the figure which determines how the insulation will stand up is the potential gradient, namely the voltage per unit length of the insulating medium.

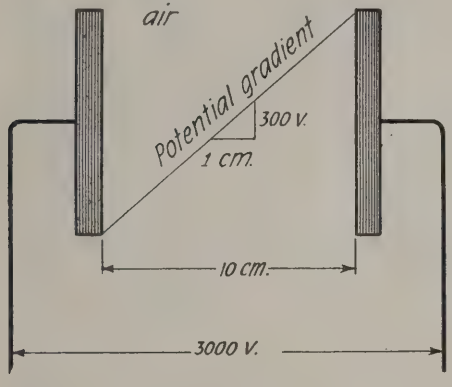


Fig. 1

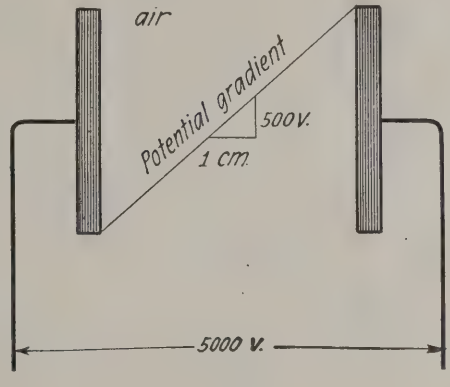


Fig. 2

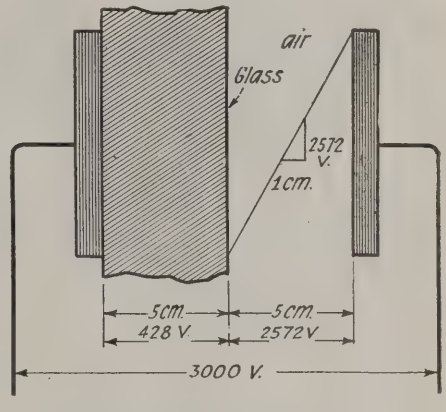


Fig. 3

Various insulating mediums and their potential gradients

The potential gradient simply tells how the voltage is distributed throughout the insulator. Thus if we have as in figure 1, 3,000 volts applied through 10 centimeters of air the voltage is distributed uniformly so that there are 300 volts across each centimeter of air. If, on the other hand, we had 5,000 volts applied across the same distance the voltage gradient would be 500 volts per centimeter of air, and there would be greater possibility of breaking down the insulation. Now this voltage distribution or gradient throughout an insulator may be designated by a straight line as in figure 1. Since the positive terminal is at the highest voltage and the negative at the lowest, the straight line slopes as shown. But the important point is that the slope of the line is such that it falls down 300 units or volts for each centimeter distance, hence this line shows how the voltage is distributed throughout the insulator. The greater this slope is the greater is the strain on the insulator. Thus in figure 2 we have the same spacing between the two terminals but the line slopes more, in fact it slopes so much that it falls 500 units or volts for each centimeter. This means that the potential gradient is 500 volts per centimeter, hence the strain on the insulating medium is greater. In other words a steep slope for the potential gradient means greater strain on the insulator.

Suppose now that we insert a thick slab of glass between the two electrodes in figure 1, say the glass is five centimeters thick. The breakdown voltage of glass is greater than that of air, that is glass is a better insulator. It might be thought therefore that the presence of this five-centimeter-thick glass slab will improve the insulating qualities. As a matter of fact it will make matters worse.

In figure 3 we have the two electrodes spaced ten centimeters apart, a sheet of glass insulation 5 centimeters thick, air insulation 5 centimeters thick, and we have applied 3,000 volts between the electrodes as in figure 1. Now the 3,000 volts are distributed across 10 centimeters of space as figure 1, only this time they are not distributed uniformly, because the capacity of glass is entirely different from that of air. Here it is necessary to explain some electrical facts. When a voltage is applied between two electrodes as in figure 1 with air between, these electrodes become charged with a certain amount of electricity depending upon the voltage and the insulating medium and the space between them. If another material is used as insulator instead of air, say glass, then the same voltage will put a greater charge on the electrodes, because glass has a greater capacity for storing electricity than air. Actually it has about six times the capacity. If we have two similar appliances, one having air as the dielectric or insulating medium, the other having glass, then if both have the same charge in them, the glass will require one-sixth the voltage, because its capacity is six times as great as air. It is as though glass had one-sixth the resistive power and therefore required one-sixth the voltage that air does.

Now let us go back to figure 3 where we have equal amounts of glass insulation and air insulation, five centimeters of each, and 3,000 volts between them. The total voltage is divided between the equal amount of glass and air insulation, but it is not divided equally between them, that is there are not 1,500 volts across the air and 1,500 volts across the glass. The reason for this is explained above. The two plates in figure 3 have the same charge, one is charged to plus 3,000 volts the other is charged to minus 3,000 volts, and since they are part of the very same apparatus the electric charges on each of them are identical. But as glass has six times the capacity of air it will take just one-sixth the voltage air will take to give it the same charge as air has. This means that of the entire 3,000 volts the air will require six parts, while the glass will require only one part (1/6th of air), to give the same charges of electricity. In other words there will be 2,572 volts across the air insulation, and only 428 volts across the glass insulation, this being one-sixth of 2,572.

Thus by inserting some glass insulation we have changed the voltage distribution as follows: Formerly in figure 1 when we had only air insulation the entire 3,000 volts were distributed across 10 centimeters of air, giving us a voltage gradient of 300 volts per centimeter: When we inserted an equal amount of glass insulation, namely five centimeters thick, as in figure 3, the voltage distribution was altered so that 2,572 volts were distributed across the five centimeters of air, giving a voltage gradient of 514 volts per centimeter, while only 428 volts were distributed across the glass, giving a voltage gradient of about 85 volts per centimeter of glass. Thus the insertion of glass resulted in increasing the voltage gradient across air from 300 volts per centimeter as in figure 1, to 514 volts per centimeter as in figure 3.

This occurs whenever two different types of insulators are used in series. The addition of another good dielectric does not improve insulation, it always throws an extra burden on the weaker insulating material, as was seen in the above numerical illustration. Although glass is a stronger insulator, still its presence simply increased the strain on the weaker insulating medium of air. If any change in the insulating qualities of the dielectric must be made the change must be a complete one. In the case of figure 3, instead of using part glass and part air, use all glass.

The above figures should show experimenters conclusively that nothing is gained by using two insulating materials in series. This applies whether direct or alternating currents are used.

Factors of Wavemeter Design and Operation

By L. R. Felder

IN the design of any radio unit or complete set there are certain prime conditions that the designer seeks to fulfill, which conditions are characteristic of the item being designed. Thus in designing inductances the goal aimed at is to get the required inductance with a minimum of resistance, in other words to make the L/R ratio as great as possible. In the case of a transmitter the goal aimed at is to secure the necessary power radiation at maximum efficiency. In the design of wavemeters, the subject of this article, the problem boiled down is to secure highly selective tuning and a low damping factor. Let us see why and how these conditions have to be met.

As its name implies the wavemeter is used essentially to measure wave length. However this is not the only use to which this instrument can be put. It is used to measure capacities, inductances, decrements, coupling coefficients. It can be used to secure resonance curves and other data as to the nature of radiated waves, to calibrate receivers and transmitters and so on. Obviously all these measurements which are made with the wavemeter depend for their accuracy upon the ability of the wavemeter to tune sharply to the wave at which measurements are made. Thus suppose we have a wavemeter whose resonance curve has the shape of figure 1, a broad resonance curve, and suppose that measurements are to be made at the wave length λ_0. It will be observed that the current effect over a wide band of wave lengths between λ_1 and λ_2 is about the same and that on either side of this band the current effect is still very considerable. In other words, due to this broad tuning of the wavemeter it would be very difficult to tune it to exactly the wave length required, as a result of which considerable inaccuracies will be made. The broader the tuning of the meter the larger will the inaccuracies be. If on the other hand the resonance curve of the wavemeter were as shown in figure 2, tuning to any given wave length could be accomplished with considerable accuracy and measurements would then be more reliable.

What is required then in the wavemeter is a design so that a sharp resonance curve is secured. This is primarily dependent upon the decrement of the wavemeter circuit. To illustrate this figure 3 shows three resonance curves of the same circuit, each curve having been secured with different resistance, thus varying the decrement. Thus curve C has twice the decrement of curve B, and about four times the decrement of curve A. The low decrement produces the sharp resonance curve. Wavemeter design, then, aims to secure a wavemeter to cover a definite range of wave lengths which shall have a minimum damping factor.

The wavemeter is essentially a coil and condenser combination, one of these elements —usually the condenser—being variable, which combination is so calibrated that the condenser instead of reading capacities will read wave length. Thus if the condenser at any setting has a capacity of C microfarads, and the inductance is L microhenries, the combination will have a definite wave length given by the formula.

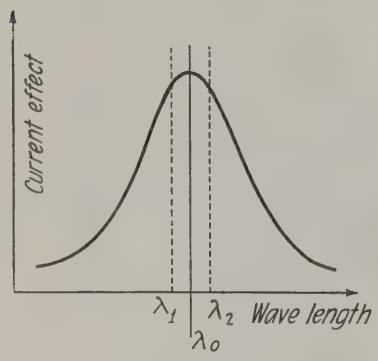


Figure 1

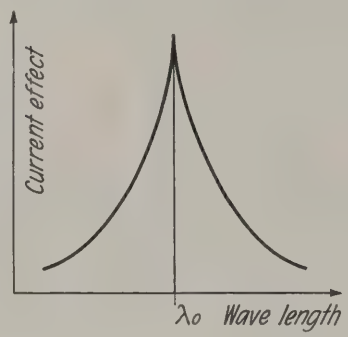


Figure 2

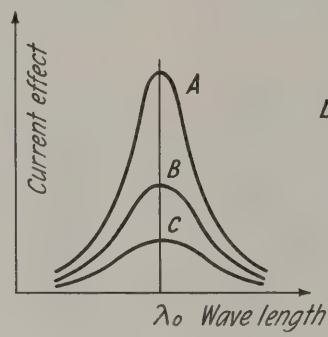


Figure 3

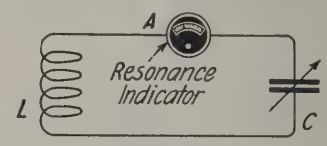


Figure 4

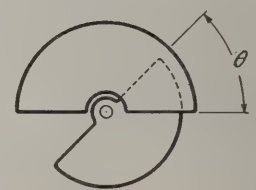


Figure 5

Diagrammatic details of wavemeter design and operation

$$\lambda = \sqrt{L \times C \times 1885}$$

This wave length may be calculated for each setting of the condenser, and a curve plotted of wave length against condenser setting, in this way securing a calibration of the wavemeter. However there must be used in conjunction with the coil and condenser some indicating device to show when the condition of resonance is secured, as for example a radio frequency ammeter, or thermo-couple and galvanometer, or crystal detector and telephones. Then there are also the connecting wires. Both of these factors have to be taken into consideration for they may possess sufficient inductance and capacity to destroy, if their effect is neglected, completely the accuracy of the calculation. Hence the wavemeter is generally calibrated against a standard, and all the accessories of the wavemeter are in circuit as actually used, so that their effect is thus accounted for.

In the wavemeter circuit of figure 4 the decrement is dependent upon the total inductance, capacity and effective resistance of the circuit, and is given by the equation

$$\delta = \pi R \sqrt{\frac{C}{L}}$$

From this equation it is seen that the higher the effective resistance of the circuit the greater will be the damping and hence the broader the tuning, which is undesirable. The effective resistance of the circuit is mainly made up of the coil resistance and resistance of connections and resonance indicator. The resistance of the capacity may be neglected as this is always an air condenser and hence loss-free. The resistance of connections will always be quite low and negligible if care is taken to so dispose of the wavemeter elements as to make the connections very short. If the resonance indicator is placed in series with the coil and condenser, as for example, an ammeter, its resistance should be low. In the case of indicators which are placed in shunt connection, as is the case when a vacuum tube is used, its resistance should be extremely high, otherwise it will introduce high effective resistance in the wavemeter circuit. In general, however, the chief resistance is that due to the wavemeter inductance.

The wavemeter inductance L affects the decrement in two opposite ways: (1) From the equation we see that the larger we make the inductance the lower will the decrement be, which is what is desired. However we cannot increase this inductance to too high values for (2) the larger the inductance the higher will the resistance of the coil be, and from the equation above this results in increased decrement. In other words it is disadvantageous to increase the inductance beyond a certain value as otherwise harmful effects of resistance enter. In a similar manner a reduction of the inductance to too low values would be harmful also, for although the reduction in coil resistance affected thereby would result in lowering the decrement this would be more than counterbal- the diminished inductance, as seen from the equation for damping. Thus the choice of inductance must be a compromise between two extreme values, and in general is based upon the values of capacity which are employed in the wavemeter.

In the case of capacity, too high values are not desirable for the simple reason that allowance must be made for sufficient inductance to act as the coupling coil of the wavemeter. Furthermore, high values of capacity mean high decrements and hence broad tuning. In practice the best designs are such that the wave length range of the wavemeter for a given coil is about 3 to 1. This means that the condenser should have a maximum to minimum capacity ratio of about 9 to 1. Most commercial condensers are built to have a ratio of about 10 to 1,

which is therefore quite satisfactory. The commercial wavemeters are built to have maximum capacities of about 0.0005 and 0.001 microfarad. These will be found to be suitable values on which to base calculations for the inductance coils. Which value to use depends upon the maximum wave length it is desired to cover. If in the low wave length band, say up to 1000 meters, the 0.0005 microfarad condenser will be found the better. Above this it is best to use the 0.001 condenser, as otherwise the inductance coil will be found to be too great.

With a given condenser it is possible to cover a wave length range much greater than the 3 to 1 range given above. Thus suppose we desire to build a wavemeter to cover the range of wave lengths from 200 to 3000 meters. We would use a 0.001 microfarad condenser and design one coil for this to tune to 600 meters. In this way with this one coil we would secure a wave length range of 3 to 1, namely from 200 to 600 meters. We would then design another coil which would tune with the condenser to a maximum wave length of say about 1500 meters. With this coil, then, we could cover the range between 500 and 1500 meters. A third coil could then be designed to give a maximum wave length of about 3600 meters, thus covering a wave length range with this coil of 1200 to 3600 meters. This is the method generally followed in the practical design of wavemeters where a wide band of wave lengths is to be covered. An important point to observe in this connection is the so-called "overlap." Coil A covers the range between 200 and 600 meters, coil B covers the range between 500 and 1500 meters. The second range overlaps the first range between 500 and 600 meters. This "overlap" would, in commercial practice be made a little larger, say from 450 meters to 600 meters. The smaller the overlap, of course, the fewer coils will be required to cover a given wave length range. It is thus possible to check the accuracy of wave length measurements which occur at the extreme ends of the condenser scale by measuring with two different coils.

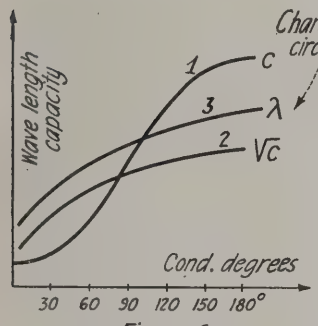


Figure 6

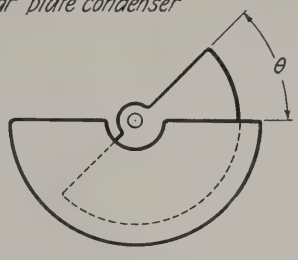


Figure 7

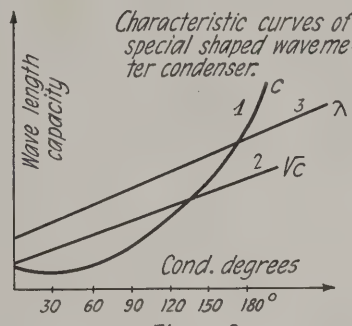


Figure 8

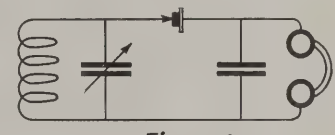


Figure 9

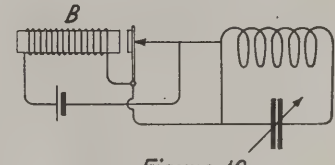


Figure 10

Details of wavemeter design and operation

The Wavemeter Condenser

The ordinary semicircular plate condenser has some disadvantages when used in a wavemeter. Figure 5 shows diagrammatically the semicircular plate condenser moved through an angle of θ degrees. This particular type of condenser gives a capacity which is approximately proportional to the angle through which the movable plates are moved, and this fact is shown in curve 1 in figure 6. The other curves, namely 2 and 3 in that figure show how C varies with the angle of displacement and how the wave length varies with capacity and angle of displacement. It will be seen from the wave length curve that at the lower values of capacity the wave lengths, for small changes in capacity, make large changes Therefore at the lower end of the capacity scale the wave length scale will be very crowded while at the upper end of the scale the wave length scale will be wide open. This non-uniform scale is very undesirable for it makes the reading of wave length at the lower end extremely difficult and due to the crowded scale inaccuracies are very liable to arise.

What is desired is a uniform wave length scale so that equal increases in wave length are secured by equal movements of the rotating condenser plates. This can be accomplished only by means of specially formed plates as shown in figure 7. The fixed plates are semicircular, but the rotating plates are specially shaped, and the shaft is eccentrically located as seen in the figure. Figure 8 gives the various curves which characterize this particular form of condenser. It will be seen that the capacity of this condenser is no longer directly proportional to the angle through which the rotating plates move. In spite of this, however, the wave length scale is uniform, for the wave length is proportional to the square root of capacity, and from curve 2 it is seen that the C curve is a straight line curve. Thus the wavemeter scale with this type of condenser is not crowded but uniform and hence more accurate results are obtainable. This type of condenser is marketed by some firms and is to be strongly recommended to amateurs considering the construction of a wavemeter.

Coupling of Wavemeter

In the use of the wavemeter the most important rule to observe pertains to the coupling of the wavemeter, and is: Always use very loose coupling. No results will be reliable unless this rule is strictly adhered to. There are two reasons for this. In the first place, coupling a wavemeter closely to a circuit effects a reaction between the two circuits. In a wavemeter measurement the wavemeter must react to the other circuit, but there must be no reaction in the direction of wavemeter to the other circuit, otherwise this double reaction will produce coupling waves, which detract from the accuracy of the measurement. Secondly, with very loose coupling there is no change produced in the constants of wavemeter and the other circuit. At close couplings there is considerable energy withdrawn from each circuit and transferred to the other. This is equivalent to increasing the effective resistance of each circuit. Hence the damping will increase and broad tuning will result, which destroys the accuracy of the measurements as stated above.

In order to be able to couple the wavemeter very loosely to the source of oscillations it is necessary to employ sensitive resonance indicators. In the case of measurements being taken on a transmitting set the best type of indicator to use is a radio frequency ammeter of some sort. In the case of measurements being taken on receiving equipment where the oscillating currents are very small, more sensitive indicators must be employed. In some cases of laboratory measurements thermocouples and galvanometers are employed. For station work such meters are not generally employed, but a crystal detector and telephones are used instead.

The use of a crystal detector and telephones on a wavemeter as in figure 9 introduces certain corrections to the wavemeter calibration which must be taken care of. The combination of crystal and phones has a capacity effect which may be of the order of 0.000005 microfarad, and this may alter the wave length calibration of the meter by as much as 4 or 5 per cent. Consequently the wavemeter should be calibrated with the indicator in circuit or the effect of the indicator should be taken account of by calculation. Of course the greater the wavemeter capacity, relative to the capacity of the resonance indicator, the less effect will the indicator have on the calibration.

A wavemeter cannot only be used as a receiving wavemeter, but may also be a transmitting wavemeter. In a great many measurements, as inductance and capacity measurements of coils and condensers it is necessary to provide an external source of oscillations to excite the circuit in which the measured element is connected. This is most easily accomplished by means of a transmitting wavemeter as in figure 10. A vibrating buzzer B is used as the means of exciting oscillations in the wavemeter circuit which oscillations are then transmitted to the circuit under test. The incorporation of a buzzer in a wavemeter enables many measurements to be made which would otherwise not be convenient to make. When the wavemeter is used as a transmitter it should be recalibrated with the buzzer in circuit, as the capacity effect of the buzzer may alter the calibration to a marked extent.

Popular Misconceptions of Radio

By G. H. Clark

I had an intense interest in medical matters during one of the boyish crazes that I went through in common with all other youngsters. Whenever I had a chance, I asked questions of my physician friends, and I read every book I could find on physiology and materia medica. I thought of course, that I knew a lot about the matter, but I remember now how my ostentatious use of technical terms brought a smile to the lips of those who really knew the subject. I remember that smile of my doctor friends. It comes in very handy these days to remember it, when eager beginners in radio ask me the same kind of questions that I used to ask.

Now it is an obvious fact that the body can be used fairly well without the knowledge that the physician has. You and I walk quite naturally without appreciating or knowing the wonderful series of muscles and controls that we are using. The same is true of radio. The beginners—both amateurs and novices—who operate receivers and get wonderful results out of them are often totally ignorant of what they are doing. Many of them know little more than that there are several dials to adjust, but what these dials do is a complete mystery. Sometimes it seems as if the less one knows about radio the better results one can get.

There are a few popular misconceptions about radio, however, which actually do harm. The first, and most common one, is that the receiving antenna has to point in a certain direction to receive a given station best. This is not true at all of the antennas used in broadcast reception. To have the quality of "directivity" referred to, an antenna must have very great length compared to the height, such as the antenna used by the Radio Corporation of America at Riverhead, L. I., which is thirty feet high and nine miles long. But the ordinary broadcast antenna, with its length of a hundred feet or so, will receive your favorite broadcast stations equally well, whether the wire be pointing north, south, east, or west.

Others, misled doubtless by the analogy of a violin string, think that an antenna will not receive unless it is stretched tight. I recall a classic case where an old-time Naval officer refused permission to tune up a set on board ship because the antenna wires were not stretched taut. Others go still farther, and think that if one were to tie an insulator to some point along the middle of the horizontal wire—as might be done to keep it away from a tree near its path—this would stop the antenna from vibrating and prevent signals from being received. There is no truth in these beliefs at all. They are due to confusion of mechanical vibration and electrical vibration, which are two entirely different things. The former means actual physical movement of the wire; the latter means that electric currents are set up in it from a distant station. One action has no relation to the other. The antenna may be humming away like a telegraph wire on a cold night, or it may be guyed at twenty different places, and it will receive equally well in both cases.

People have funny ideas about ground connections, too. One man complained about poor reception from his receiver, and when the wiring was examined it was found that he had run his ground wire down to a tack driven through the carpet.

A very common and incorrect idea is that the larger the physical size of a coil the greater distances can be covered. A customer in a store the other day brought in a honeycomb coil, size 50, saying that she wanted instead one of the big size 1500 coils, so she could pick up Chicago on her broadcast receiver. Now such a large coil as she desired could only be used for long waves, such as the 15,000-meter wave used between Radio Central and Europe, and had she used it for broadcast reception, she would have received nothing at all, rather than an increased signal.

Another customer, a man this time, asked me to advise him on the way to connect up a set he was building. He carefully explained that he was using honeycomb coils and a forty-three-plate condenser and a variocoupler, and he wanted to connect up a radio frequency amplifier. I handed him a little circuit diagram that was at hand, and he replied, "Oh, I have that already, but it won't do. It shows cylindrical coils whereas I am using honeycombs." Undoubtedly there are many beginners who think that there is some especial kind of inductance in a honeycomb coil or a spider web compared with an ordinary cylindrical one! There isn't. A coil is a coil. What counts most is its inductance, and this depends greatly on how many feet of wire there are in the coil. The method of winding is a minor matter.

Incorrect ideas such as these greatly hinder the progress of radio. The whole trend is toward the idea that radio is complicated and mysterious, whereas if the few elementary circuits and laws are studied, it is simple and quite ordinary. Too much stress cannot be laid on clearing up the confusing ideas that are so prevalent and so undesirable.

What Is the Range of My Receiver?

PROBABLY the hardest question to answer in radio is the one most commonly asked, what is the range of the different types of receivers? The reason the answer is so hard to give is because there is *no* answer, at least no definite one.

It would be hard indeed to give an intelligent reply to anyone asking, "How far can one go in a day by automobile?" Obviously, it depends on the condition of the roads; on the make of car; and finally on the expertness of the driver. But the answer to the radio question depends on many more factors than three. First, and most important, is the location of the receiving station. If it happens o be in a locality where the ground conditions are good, that is one very important factor in its favor. If again there are no metal buildings, or trees, in the immediate vicinity, that also helps greatly. Then comes the matter of an antenna, a rather minor factor at that, but it enters in. The condition of the atmosphere between you and the station you want to receive is an enormously important matter, and one that is entirely out of your control. Lastly, of course, you want a reliably built set, and you need to know how to handle it.

From the standpoint of the antenna and ground conditions, we can say that if you live in the country you are likely to have a very great receiving range; if you live in the suburbs of a city you will have a good range, and if you live in the heart of a city itself you will find that your receiving distance is cut down considerably. For this reason, the only fair way to estimate the range of a receiving set, without knowing the location of its use, is to give the range that can conservatively be expected under the worst conditions. Then, if the questioner has conditions better than these, he will be gratified by getting distances greater than he anticipated. Much harm is done to radio by irresponsible salesmen blithely guaranteeing reception of Cuba or Los Angeles when perhaps the prospective purchaser lives in the city in the shadow of a number of steel apartment buildings.

We know little of the question of ground conditions, meaning by this not the local ground for your set, but the "density" of radio energy in your particular locality. As the waves sweep over the surface of the earth, any particularly good conducting stretch will cause the waves to crowd over and take advantage of this, leaving the land nearby comparatively free. Thus a lake or river improves local conditions and robs the adjacent territory. An important test was made some time ago at Oil City, Pa., where signals from KDKA were very weak indeed, whereas many miles farther away signals were picked up very loud. Investigation showed that the city was entirely surrounded by ore deposits, which diverted practically all the waves so that they actually passed the town by on their way. In much the same way, one of the German high power stations has never been able to get its anticipated distance of transmission, because, although its local ground is excellent, it has been found that the region as a whole is set in a huge stone "bowl," which prevents good contact with the surface of the earth in general. The fact that certain stations work excellently in one direction and poorly in others may be due to particularly good ground conditions which stretch out in one particular direction. This may explain why owners of crystal sets in Pittsburgh report common reception from Schenectady, station WGY, a truly remarkable record.

As to your own ground conditions, a water pipe ground is ideal. If this cannot be obtained, approach it as nearly as you can by driving galvanized iron rods in the earth.

The antenna that you should use for long distance work should be a single wire, well-insulated, as high as you can get it at both ends, and with a total length (both vertical and horizontal) of about one hundred and fifty feet. The direction of the antenna makes no difference at all, except that if you cross electric light wires you would do well to cross them at right angles.

It will be found excellent to install two antennas, one the long distance type described above, and another short one, say twenty feet or so in length, for local work. The latter may be an indoor antenna if you so desire. On this small antenna you will get plenty of signals from your nearby broadcasting stations and you will find the occasional interference problem greatly helped by this simple device. A switch for throwing to either antenna at will completes your installation. Do not forget to have a reliable and approved lightning arrester on both antennas, if both are out of doors.

Keeping in mind that the ranges given are those which almost every set can attain, no matter how poor its location, the following general principles can be given. If your home is situated in the suburbs, you will do much better than the figures given, in all probability, and if you are a country dweller your chances are still better.

A crystal set, that is, a receiver with crystal detector, will cover a range of twenty-five to fifty miles.

A receiver with a vacuum tube detector and with the regenerative or tickler circuit will be good for two hundred miles. This is partly due to the better action of the vacuum tube as detector compared with the crystal detector, but the greater increase in the range is due to the regenerative circuit. This acts to increase the sensitiveness of the detector, and also serves another useful purpose, namely, to reduce the antenna resistance and make the set sharply tuned.

A receiver with a vacuum tube detector and two stages of audio amplification will bring the range of your set up to about eight hundred miles. Where the conditions are favorable, such a set will bring in stations almost over the entire American continent, but the conservative range of eight hundred miles gives the lower limit which is almost certain to be obtained by anyone. Another advantage of the amplifier is that with it loud speaker operation is possible, a factor greatly desired by most listeners.

Fundamentals of Wireless

By C. Dwight Briggs, B. S., E. E.

SOUND in its common meaning refers to the sensation received by the ear. In scientific work the cause of that which produces this sensation is studied. This cause has been found to be the result of vibrations—these vibrations giving rise to impulses or waves.

When a table is struck or a musical note "sounded," there radiates from the source of energy vibrations which are transmitted in all directions through the air by sound waves. The simple fundamental process is then, an acting force causing elastic vibrations which set up a wave motion in the air, the transmitting medium, until the ear drum receives them causing the sensation of sound.

Man communicates with man by conversation. Party number one acts upon his vocal organs causing the air to vibrate, the air transmits the sound waves to the ear drum of number two.

Conclusion number one: There can be no sound, no transmission of the sound waves, without vibration. A laboratory experiment used by physicists to demonstrate the characteristics of the transmission of sound utilizes an electric bell in a bell jar; so long as air is in the jar the bell can be heard, but as the air is exhausted the sound becomes less and less, and finally as the vacuum is established the sound ceases. Why? Nothing to vibrate.

Wireless communication is then the primitive form, but its limits depended upon the muscular force of the sender's vocal organs. The Indians would place their heads upon the ground to hear the approach of beasts or foe. The ground was the medium to vibrate. Very early man noticed that if some medium could be made to vibrate, distance transmission would be increased.

No great steps were made until the telephone was invented. The old principle is used, but its adaptation is brought about electrically. The transmitter changes sound waves to electric impulses; the wire transmits these electric impulses; the receiver transforms these electric impulses to sound waves. Distance is practically nil. The efficiency of electric transmission defines the limits.

Distance communication is divided into four steps. First—Changing sound waves into some waves or impulses that are easily transmitted. Second—Transmitting these waves through some medium. Third—Receiving these impulses. Fourth—Changing these impulses back to sound waves.

Present-day wireless does these things, but the transmitting medium is a dielectric acted upon by high frequency electro-magnetic waves. The sending or broadcasting stations come under item one. The thousands of receiving sets under three and four. Rather than confuse ourselves with the technical ways and means of accomplishing these just remember that this fundamental principle cannot be changed. Regardless of bulbs, rheostats, condensers, etc., etc., the whole scheme is to get something to vibrate.

Radio Antenna Design

(*Continued from page* 55)

siderable part of the total necessary losses.

The scope of this paper does not permit me to go into the possible methods of supplying energy to the antenna, but is merely intended to bring out the fact that the properties of the antenna as a radiator can be stated simply in terms of its effective height, and that its efficiency does not very materially depend on its particular form, but is more dependent on the conditions local to the antenna in question.

The statements, in general, refer to an antenna as used for transmitting purposes, and when used for receiving purposes, the operating conditions are different in that the antenna, in addition to being capable of radiation, is energized by an incoming wave. The energy which can be delivered to our receiving apparatus is determined by the relation of the received energy to the losses in the antenna and the energy which it radiates. As the same property which makes the antenna a receiver of energy also makes it a radiator of energy, the ability of the antenna to receive will be determined mainly by its losses, and when used with a vacuum tube regenerative receiver, these losses can be canceled by regeneration, so that the signals received by the antenna can reach a value such that it radiates the same signal, or, in other words, the current in the receiving antenna can reach a maximum value, which is such that it radiates a signal of the same intensity of that received. Consideration will show that this would make the receiving antenna independent of height, and experience shows that this is practically so within a certain limitation, due mainly to the fact that the very low antenna near the ground is usually in a position of reduced field, owing to absorption by ground and surrounding objects. There is also certain difficulty in adjusting a regenerative set to such a point as to just neutralize antenna resistance but when accomplished the receiver operates at its best efficiency for quality as well as range.

Radio Equipment of the ZR-1

(*Continued from page* 49)

the electrical power equipment of an automobile, is carried aloft on the ZR-1 in the event of a breakdown of the gasoline-driven generator. This would supply power for about two hours. The electric energy derived from the generator not only operates the radio instruments but furnishes electricity for lighting the airship.

The wireless instruments are installed on the forward position of the control car, shown in the photograph reproduced with this article. The call letters assigned are "ZR-1," bearing the designation of this dirigible. The comparatively great height of the 300-foot trailing wire antenna will, it is anticipated, make for effective long-distance communication. Therefore, with both adequate sending and receiving wireless instruments, together with a radio compass, the ZR-1, in the event of a voyage to the North Pole, should be able to maintain communication with the outside world.

BROADCASTING STATION DIRECTORY

(Revised to September 20th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop.....Monterey, Calif.	261
KLS	Warner Brothers.....Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Co...Fresno, Calif.	360
KMO	Love Electric Co.....Tacoma, Wash.	360
KNJ	Roswell Public Service Co.....Roswell, N. M.	250
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	286
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros. .....San Francisco, Calif.	423
KQI	University of California.....Berkeley, Calif.	360
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreld.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co..San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co..Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop .....Honolu'u, T. H.	360
KYW	Westinghouse Elec. & Mfg. Co.....Chicago, Ill.	536
KZM	Preston, D. Allen.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co..Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co..Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre .....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology..Portland, Ore.	360
KDYS	The Tribune, Inc.....Great Falls, Mont.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co....Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company .....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co....Reno, Nev.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZT	Seattle Radio Association.....Seattle, Wash.	360
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	360
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	Electric Shop .....Moscow, Idaho	360
KFAP	Standard Publishing Co.....Butte, Mont.	360
KFAQ	City of San Jose.....San Jose, Calif.	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFAY	W. J. Virgin Milling Co....Central Point, Ore.	360
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill.....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCL	Los Angeles Union Stock Yds..Los Angeles, Calif.	360
KFCM	Richmond Radio Shop .....Richmond, Calif.	360
KFCP	Ralph W. Flygare .....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr. .....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	360
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDB	Mercantile Trust Co.....San Francisco, Calif.	509
KFDC	Radio Supply Co.....Spokane, Wash.	283
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agri. College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. E. Cutting.....Bozeman, Mont.	248
KFDP	Hawkeye Radio & Supply Co....Des Moines, Ia.	278
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	360
KFEC	Meier & Frank Co. .....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation .....Denver, Colo.	360
KFEP	Radio Equipment Co.....Denver, Colo.	240
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Douglas, Wyo.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs..St. Louis, Mo.	360
KFFA	Dr. R. O. Shelton.....San Diego, Calif.	242
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Oregon	229
KFFP	First Baptist Church.....Moberly, Mo.	275
KFFQ	Markschoffel Motor Co...Colorado Springs, Colo.	360
KFFR	Jim Kirk .....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co....Mt. Vernon, Wash.	360
KFGH	Leland Stanford Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Mo., 138th Inf..St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGP	Cheney Radio Co.....Cheney, Kans.	229
KFGQ	Crary Hdw. Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGY	Gjelbaug's Radio Shop.....Baudette, Minn.	224
KFGZ	Emmanuel Missionary Co..Berrien Spgs., Mich.	268
KFHA	Colorado State Normal School..Gunnison, Colo.	360
KFHB	The Rialto Theatre.....Hood River, Oregon	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHI	Charles V. Dixon.....Wichita, Kans.	224
KFHJ	Fallon Co. .....Santa Barbara, Calif.	360
KFHL	Penn College .....Oskaloosa, Iowa	227
KFHP	Radio Bulb Products Co.....Kearney, Nebr.	246
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFHY	R. S. McEwan.....Trinidad, Colo.	242
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip Laskowitz .....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co...Juneau, Alaska	226
KFIV	V. H. Broyles.....Pittsburgh, Kans.	240
KFIX	Reorganized Church of Jesus Christ, of Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories .....Seattle, Wash.	236
KFIZ	Daily Commonwealth .....Fond du Lac, Wisc.	273
KFJA	Central Power Co.....Brand Island, Nebr.	244
KFJB	Marshall Electric Co., Inc..Marshalltown, Iowa	248
KFJC	Post Intelligencer .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co...Oklahoma City, Okla.	252
KFJH	The Sugar Bowl.....Selma, Calif.	273
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJJ	Carrollton Radio Shop.....Carrollton, Mo.	236
KFJM	University of North Dakota..Grand Forks, N. D.	229
KFJQ	Valley Radio Div. of Electric Construction Co., Grand Forks, N. D.	252
KFJR	Ashley C. Dixon & Co... ..Stevensville, Mont.	258
KFJU	Central Power Co.....Kearney, Nebr.	234
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFLE	National Educational Service.....Denver, Colo.	268
WBL	T. & H. Radio Co.....Anthony, Kansas	261
WBS	May & Co.....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBU	City of Chicago.....Chicago, Ill.	286
WBZ	Westinghouse Elec & Mfg. Co., Springfield, Mass.	337
WCE	Findley Electric Co.....Minneapolis, Minn.	360
WCK	Stix-Baer-Fuller .....St. Louis, Mo.	360
WCM	University of Texas.....Austin, Texas	360
WCX	Detroit Free Fress.....Detroit, Mich.	517
WDM	Church of the Covenant.....Washington, D. C.	360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co. .....St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGF	The Register & Tribune.....Des Moines, Iowa	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	360
WGV	Interstate Electric Co.....New Orleans, La.	360
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHD	West Virginia University..Morgantown, W. Va.	360
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre....New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cino Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co.....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America..Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKC	Joseph M. Zamoiski Co. .....Baltimore, Md.	360
WKY	Oklahoma Radio Shop....Oklahoma City, Okla.	360
WLB	University of Minnesota....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co.....Indianapolis, Ind.	360
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMH	Precision Equipment Co.....Cincinnati, Ohio	248
WMU	Doubleday-Hill Elec. Co.....Pittsburgh, Pa.	261
WNJ	Shotton Radio Mfg. Co.....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, N. J., Jersey City, N. J.	360
WOC	Palmer School of Chiropractic...Davenport, Iowa	484
WOI	Iowa State College.....Ames, Iowa	360
WOK	Arkansas Light & Power Co...Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co.....Kansas City, Mo.	360
WOR	L. Bamberger Co.....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record.....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm.....New Lebanon, Ohio	234
WPI	Electric Supply Co.....Clearfield, Pa.	360
WQX	Walter A. Kushi .....Chicago, Ill.	360
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co....Hamiliton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab.Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co.....Utica, N. Y.	273
WSY	Alabama Power Co.....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co. .....Toledo, Ohio	360
WTG	Kansas State Agr. College....Manhattan, Kans.	360
WTP	George M. McBride.....Bay City, Mich.	360
WWB	Daily News Printing Co.....Canton, Ohio	360
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	The Detroit News.....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WWZ	John Wanamaker .....New York, N. Y.	360
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal.....Chicago, Ill.	286
WAAH	Commonwealth Electric Co.....St. Paul, Minn.	360
WAAK	Gimbel Bros. .....Milwaukee, Wisc.	280
WAAM	L. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAP	Otto W. Taylor.....Wichita, Kans.	360
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co.....Decatur, Ga.	360
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.....Emporia, Kans.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence.....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.....Anderson, Ind.	229
WABD	Parker High School.....Dayton, Ohio	286
WABE	Y. M. C. A.....Washington, D. C.	283
WABF	Mt. Vernon Register-News Co..Mt. Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co....Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College.....Storrs, Conn.	283
WABM	F. E. Doherty.....Saginaw, Mich.	254
WABN	Waldo C. Grover.....La Crosse, Wisc.	234
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WAJV	Indian Pipe Line Corp.....Princeton, Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	360
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Ft. Worth, Tex.	476
WBAU	Republican Publishing Co.....Hamilton, Ohio	258
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	246
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBC	Sterling Radio Equipment Co....Sterling, Ill.	229
WBBD	Barbey Battery Service.....Reading, Pa.	224
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufman & Baer Co.....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel.....Houston, Tex.	360
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co.....San Antonio, Tex.	360
WCAS	Dunwoody Industrial Institute, Minneapolis, Minn.	246
WCAT	South Dakota School of Mines..Rapid City, S. D.	240
WCAU	Durham & Co.....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont.....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Music House, Milwaukee, Wisc.	261
WCBA	Charles W. Haimbach.....Allentown, Pa.	280
WCBB	K. & K. Radio Supply Co....Greenville, Ohio	240

WCBD	Zion Radio Broadcasting Station.....Zion, Ill.	345
WDAD	Central Kansas Radio Supply..Lindsborg, Kans.	360
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star.....Kansas City, Mo.	411
WDAG	Martin J. Laurence .....Amarillo, Tex.	263
WDAH	Trinity Methodist Church.....El Paso, Texas	268
WDAI	Hughes Radio Corporation.....Syracuse, N. Y.	246
WDAJ	Atlanta & West Point R. R. Co., College Park, Ga.	360
WDAK	Hartford Courant .....Hartford, Conn.	261
WDAL	Florida Times Union.....Jacksonville, Fla.	360
WDAM	Weston Electric Co.....New York, N. Y.	360
WDAO	Automotive Electric Co.....Dallas, Tex.	360
WDAP	Midwest Radio Central, Inc.....Chicago, Ill.	360
WDAR	Lit Brothers .....Philadelphia, Pa.	395
WDAS	Samuel W. Waite .....Worcester, Mass.	360
WDAU	Slocum & Kilburn.....New Bedford, Mass.	360
WDAX	First National Bank.....Centerville, Iowa	268
WDAY	Fargo Radio Service Co.....Fargo, N. D.	244
WDBC	Kirk Johnson & Co., Inc.....Lancaster, Pa.	258
WDBF	Robert G. Phillips.....Youngstown, Ohio	261
WEAA	Fallain and Lathrop.....Flint, Mich.	280
WEAB	Standard Radio Equipment Co..Fort Dodge, Ia.	360
WEAE	Virginia Polytechnic Institute...Blacksburg, Va.	360
WEAF	American Tel. & Tel.....New York, N. Y.	492
WEAG	Nichols Hineline Bassett Laboratory, Edgewood, R. I.	231
WEAH	Wichita Board of Trade.....Wichita, Kans.	244
WEAI	Cornell University .....Ithaca, N. Y.	286
WEAJ	University of South Dakota....Vermilion, S. D.	360
WEAK	Julius B. Abercombe.....St. Joseph, Mo.	360
WEAM	North Plainfield, Borough of N. Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. .....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co., Inc.....Mobile, Ala.	360
WEAR	Baltimore Am. & News Pub. Co., Baltimore, Md.	360
WEAS	Hecht Company .....Washington, D. C.	360
WEAU	Davidson Brothers Co. .....Sioux City, Iowa	360
WEAY	Will Horwitz, Jr.....Houston, Tex.	360
WEAZ	Donald Redmond .....Waterloo, Iowa	360
WFAA	A. H. Belo & Co.....Dallas, Tex.	476
WFAB	Carl C. Weese .....Syracuse, N. Y.	234
WFAF	Henry C. Spratley.....Poughkeepsie, N. Y.	273
WFAG	Radio Engineering Laboratory, Waterford, N. Y.	360
WFAH	Electrical Supply Co.....Port Arthur, Tex.	360
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAM	Times Publishing Co.....St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co..Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo.	360
WFAT	Daily Argus Leader.....Sioux Falls, S. D.	360
WFAV	University of Nebraska.....Lincoln, Nebr.	360
WGAC	Orpheum Radio Stores Co.....Brooklyn, N. Y.	360
WGAD	Spanish Am. Sch. of Telegraphy, Ensonada, P. R.	360
WGAJ	W. H. Glass.....Shenandoah, Iowa	360
WGAL	Lancaster Elec. Supply & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd.....Pensacola, Fla.	360
WGAQ	W. G. Patterson.....Shreveport, La.	360
WGAR	Southern American .....Fort Smith, Ga.	360
WGAU	Marcus G. Limb.....Wooster, Ohio	226
WGAW	Ernest C. Albright.....Altoona, Pa.	261
WGAX	Radio Electric Co., Washington Courthouse, Ohio	360
WGAY	North Western Radio Co.....Madison, Wisc.	360
WGAZ	South Bend Tribune.....South Bend, Ind.	360
WHAA	State University of Iowa.....Iowa City, Iowa	283
WHAB	Clark W. Thompson.....Galveston, Tex.	360
WHAC	Cole Brothers Elec. Co.....Waterloo, Iowa	360
WHAD	Marquette University.....Milwaukee, Wisc.	360
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	J. T. Griffin .....Joplin, Mo.	360
WHAK	Roberts Hardware Co.....Clarksburg, W. Va.	360
WHAL	Lansing Capital News.....Lansing, Mich.	248
WHAM	School of Music, Rochester Univ., Rochester, N. Y.	360
WHAO	F. A. Hill.....Savannah, Ga.	360
WHAP	Dewey L. Otta.....Decatur, Ill.	360
WHAQ	Semmes Motor Co.....Washington, D. C.	242
WHAR	Paramount Radio and Elec. Co., Atlantic City, N. J.	231
WHAS	Courier Journal & Times.....Louisville, Ky.	400
WHAV	Wilmington Elec. & Supply Co.,Wilmington, Del.	360
WHAX	Huntington Press .....Huntington, Ind.	360
WHAZ	Rensselaer Polytechnic Institute.....Troy, N. Y.	380
WIAB	Joslyn Automobile Co.....Rochford, Ill.	360
WIAD	Ocean City Yacht Club.....Ocean City, N. J.	254
WIAF	Gustav A. De Cortin.....New Orleans, La.	234
WIAH	Continental Radio Mfg. Co.....Newton, Ia.	360
WIAI	Heers Stores Co.....Springfield, Mo.	252
WIAK	Journal Stockman Co.....Omaha, Nebr.	278
WIAP	J. A. Rudy & Sons.....Paducah, Ky.	360
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Burlington Hawkeye-Home Elec. Co., Burlington, Ia.	360
WIAT	Leon T. Noel.....Tarkio, Mo.	360
WIAU	American Sec. & Sav. Bank.....Le Mars, Ia.	360
WIAV	New York Radio Laboratories, Binghamton, N.Y.	360
WIAW	Saginaw Radio & Elec. Co....Saginaw, Mich.	360
WIAY	Fox River Valley Radio Supply Co., Neenah, Wisc.	224
WJAD	Jackson's Radio Eng. Lab.....Waco, Tex.	360
WJAF	Press Pub. Co.....Muncie, Ind.	360
WJAG	Huse Publishing Co.....Norfolk, Nebr.	360
WJAJ	Y. M. C. A.....Dayton, Ohio	360
WJAK	Rev. C. L. White.....Greentown, Ind.	254
WJAM	D. C. Perham.....Cedar Rapids, Iowa	268
WJAN	Peoria Star Co.....Peoria, Ill.	280
WJAR	The Outlet Co.....Providence, R. I.	360
WJAS	Capper Publications .....Topeka, Kans.	360
WJAT	Kelley-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co.....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory.....Chicago, Ill.	448
WKAA	H. F. Paar.....Cedar Rapids, Iowa	268
WKAC	Star Publishing Co.....Lincoln, Nebr.	275
WKAD	Charles Looff .....East Providence, R. I.	240
WKAF	W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.	360
WKAN	Alabama Radio Mfg. Co.....Montgomery, Ala.	360
WKAP	Dutee Wilcox Flint.....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College....East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.....Springfield, Mo.	360
WKAV	Laconia Radio Club.....Laconia, N. H.	360
WKAW	United Battery Service Co., Montgomery, Ala.	226
WKAX	W. A. Macfarlane.....Bridgeport, Conn.	231
WKAY	Brenau College .....Janesville, Ga.	360
WLAC	North Carolina State College...Raleigh, N. C.	360
WLAG	Cutting & Washington Radio Corp., Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Mach. Co....Bellows Falls, Vt.	360
WLAL	Tulsa Radio Co.....Tulsa, Okla.	360
WLAN	Putnam Hardware Co.....Houlton, Me.	283
WLAP	W. V. Jordon.....Louisville, Ky.	360
WLAQ	A. E. Schilling.....Kalamazoo, Mich.	360
WLAS	Central Radio Supply Co....Hutchinson, Kans.	244
WLAT	Radio and Specialty Co.....Burlington, Iowa	360
WLAV	Electric Shop, Inc.....Pensacola, Fla.	360
WLAW	New York Police Dept.....New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station, Greencastle, Ind.	231
WLAZ	Hutton & Jones Electric Co.....Warren, Ohio	248
WMAB	Radio Supply Co.....Oklahoma City, Okla.	360
WMAC	J. Edward Page.....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co.....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.....Kansas City, Mo.	275
WMAK	Norton Laboratories.....Lockport, N. Y.	360
WMAL	Trenton Hdw. Co.....Trenton, N. J.	250
WMAM	Beaumont Radio Equipment Co...Beaumont, Tex.	360
WMAN	First Baptist Church.....Columbus, Ohio	286
WMAP	Utility Battery Service, Inc.....Easton, Ohio	246
WMAQ	Chicago Daily News.....Chicago, Ill.	448
WMAT	Paramount Radio Corporation....Duluth, Minn.	360
WMAV	Alabama Polytechnic Institute.....Auburn, Ala.	250
WMAW	Wahpeton Elec. Co.....Wahpeton, N. D.	360
WMAY	Kingshighway Presby. Church....St. Louis, Mo.	280
WMAZ	Mercer University .....Macon, Ga.	268
WNAB	Park City Daily News....Bowling Green, Ky.	360
WNAC	Shepard Stores .....Boston, Mass.	278
WNAD	Oklahoma Radio Eng. Co.....Norman, Okla.	360
WNAL	R. J. Rockwell.....Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.....Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co...Syracuse, N. Y.	286
WNAP	Wittenberg College .....Springfield, Ohio	360
WNAQ	Charleston Radio Elec. Co.....Charleston, S. C.	360
WNAR	C. C. Rhodes.....Butler, Mo.	360
WNAS	Texas Radio Corporation and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Bros. Co.....Philadelphia, Pa.	360
WNAW	Henry Kunzmann .....Fortress Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.....Yankton, S. D.	244
WNAY	Ship Owners' Radio Service....Baltimore, Md.	360
WOAA	Dr. Walter Hardy.....Ardmore, Okla.	360
WOAB	Valley Radio.....Grand Forks, N. D.	280
WOAC	Maus Radio Co.....Lima, Ohio	266
WOAD	Friday Battery & Elec. Co.....Sigourney, Iowa	360
WOAE	Midland College .....Fremont, Nebr.	360
WOAF	Tyler Commercial College.....Tyler, Tex.	360
WOAG	Apollo Theatre .....Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.....Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Texas	385
WOAJ	Ervin's Electrical Co.....Parsons, Kans.	360
WOAK	Collins Hardware Co.....Frankfort, Ky.	240
WOAL	Wm. Evans Woods.....Webster Groves, Mo.	286
WOAN	James D. Vaughan.....Lawrenceburg, Tenn.	360
WOAP	Kalamazoo College .....Kalamazoo, Mich.	360
WOAR	Henry P. Lundskow.....Kenosha, Wisc.	360
WOAT	Boyd Martell Hamp.....Wilmington, Del.	360
WOAV	Pennsylvania National Guard.....Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Nebr.	526
WOAX	Franklyn J. Wolff.....Trenton, N. J.	240
WOAZ	Penick Hughes Co.....Stanford, Tex.	360
WPAB	Pennsylvania State College...State College, Pa.	360
WPAC	Donaldson Radio Co.....Okmulgee, Okla.	360
WPAD	Wieboldt & Co.....Chicago, Ill.	360
WPAF	Peterson's Radio Co.....Council Bluffs, Iowa	360
WPAG	Central Radio Co., Inc.....Independence, Mo.	360
WPAH	Wisconsin Dept. of Markets....Waupaca, Wisc.	360
WPAJ	Doolittle Radio Corporation..New Haven, Conn.	268
WPAK	No. Dakota Agricultural College...Farge, N. D.	360
WPAL	Superior Radio & Telephone Co., Columbus, Ohio	286
WPAM	Awerbach & Guettel.....Topeka, Kans.	360
WPAP	Theodore D. Phillips.....Winchester, Ky.	360
WPAQ	General Sales & Eng. Co.....Frostburg, Md.	360
WPAR	R. A. Ward.....Beloit, Kans.	360
WPAS	J. & M. Electric Co.....Amsterdam, N. Y.	360
WPAT	St. Patrick's Cathedral.....El Paso, Tex.	360
WPAU	Concordia College .....Moorhead, Minn.	360
WPAY	Bangor Radio Laboratory.....Bangor, Me.	360
WPAZ	John R. Koch.....Charleston, West Va.	273
WQAA	Horace A. Beale, Jr.....Parkersburg, W. Va.	360
WQAB	Southwest Missouri State Teachers College, Springfield, Mo.	236
WQAC	E. B. Gish.....Amarillo, Tex.	360
WQAD	Whitehall Electric Co.....Waterbury, Conn.	242
WQAE	Moore Radio News Station.....Springfield, Vt.	275
WQAF	Sandusky Register .....Sandusky, Ohio	240
WQAH	Brock Anderson Elec. Eng. Co, Lexington, Ky.	254
WQAK	Appel-Higley Electric Co.....Dubuque, Iowa	360
WQAL	Cole County Tel. & Tel. Co.....Mattoon, Ill.	258
WQAM	Electrical Equipment Co.....Miami, Fla.	360
WQAN	Scranton Times .....Scranton, Pa.	360
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	West Texas Radio Co.....Abilene, Tex.	360
WQAS	Prince Walter Co.....Lowell, Mass.	266
WQAT	Radio Equipment Corporation.....Richmond, Va.	360
WQAV	Huntington and Guerry, Inc....Greenville, S. C.	258
WQAW	Catholic University of America, Washington, D. C.	236
WQAX	Radio Equipment Co.....Peoria, Ill.	360
WQAZ	Greensboro Daily News.....Greensboro, N. C.	360
WRAA	Rice Institute .....Houston, Tex.	360
WRAB	Savannah Board of Public Education, Savannah, Ga.	360
WRAD	Taylor Radio Shop.....Marion, Kans.	248
WRAF	Radio Club, Inc.....Laporte, Ind.	224
WRAH	Stanley N. Read.....Providence, R. I.	360
WRAL	Northern States Power Co..St. Croix Falls, Wisc.	248
WRAN	Black Hawk Electrical Co.....Waterloo, Iowa	229
WRAO	Radio Service Co.....St. Louis, Mo.	360
WRAP	Winter Park Elec. Construction Co., Winter Park, Fla.	360
WRAR	Jacob C. Thomas.....David City, Nebr.	226
WRAS	Radio Supply Co.....McLeansboro, Ill.	360
WRAU	Amarillo Daily News.....Amarillo, Tex.	360
WRAV	Antioch College .....Yellow Spring, Ohio	360
WRAW	Horace D. Good.....Reading, Pa.	238
WRAX	Flexon's Garage .....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation.....Scranton, Pa.	280
WRAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WSAA	B. S. Sprague Elec. Co.....Marietta, Ohio	360
WSAB	Southeast Mo. State College, Cape Girardeau, Mo.	360
WSAC	Clemson Agri. College....Clemson College, S. C.	360
WSAD	J. A. Foster Co.....Providence, R. I.	261
WSAH	A. G. Leonard, Jr.....Chicago, Ill.	248
WSAI	U. S. Playing Card Co.....Cincinnati, Ohio	309
WSAJ	Grove City College.....Grove City, Pa.	360
WSAK	Daily News .....Middleport, Ohio	258
WSAL	Franklin Electrical Co.....Brookville, Ind.	246
WSAN	Allentown Radio Club.....Allentown, Pa.	229
WSAP	Seventh Day Adventist Church..New York, N. Y.	263
WSAR	Doughty & Welch Elec. Co....Fall River, Mass.	254
WSAT	Plainview Elec. Co.....Plainview, Tex.	268
WSAU	Camp Marienfield .....Chesham, N. H.	229
WSAW	Curtice & McElwee.....Canandalgua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WTAB	Fall River Daily Herald....Fall River, Mass.	248
WTAC	Penn Traffic Co.....Johnstown, Pa.	360
WTAD	Robert E. Compton.....Carthage, Ill.	229
WTAG	Kern Music Co.....Providence, R. I.	258
WTAH	Carmen Ferro .....Belvidere, Ill.	236
WTAJ	The Radio Shop.....Portland, Me.	236
WTAK	Swan-Bower Co. .....Steubenville, Ohio	266
WTAL	Toledo Radio and Electrical Co., Toledo, Ohio	252
WTAN	Orndorff Radio Shop .....Mattoon, Ill.	240
WTAS	Charles E. Erbstein.....Elgin, Ill.	275
WTAU	Ruegy Battery & Elec. Co.....Tecumseh, Nebr.	360
WTAW	Agricultural and Mech. College, College Station, Tex.	254
WWAC	Sanger Brothers .....Waco, Tex.	360
WWAD	Wright & Wright, Inc.....Philadelphia, Pa.	360
WWAH	General Supply Co.....Lincoln, Nebr.	360
WWAX	Worman Brothers .....Laredo, Tex.	360

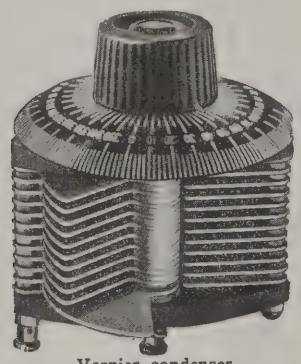
Canadian Broadcasting Stations

CKY	Manitoba Telephone System.....Winnipeg, Manitoba	
CFAC	Radio Corporation of Calgary, Ltd...Calgary, Alberta	
CFCA	Star Publishing and Printing Co., Toronto, Ontario	
CFCB	Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.	
CFCD	Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba	
CFCE	Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia	
CFCF	Marconi Wireless Telegraph Co. of Canada Ltd., Montreal, Quebec	
CFCH	Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario	
CFCI	Motor Products Corporation.....Walkerville, Ontario	
CFCN	W. W. Grant Radio, Ltd.....Calgary, Alberta	
CFCX	The London Advertiser.....London, Ontario	
CFPC	International Radio Development Co., Fort Frances, Ontario	
CFTC	The Bell Telephone Co. of Canada....Toronto, Ontario	
CFUC	University of Montreal.....Montreal, Quebec	
CFVC	Roy Russell Brown.....Courtenay, British Columbia	
CFYC	Victor Wentworth Odlum.....Vancouver, B. C.	
CFZC	Canadian Westinghouse Co., Ltd.....Montreal, Quebec	
CHAC	Radio Engineers, Ltd.....Halifax, Nova Scotia	
CHBC	The Albertan Publishing Co.....Calgary, Alberta	
CHCA	Radio Corporation of Vancouver, Ltd., Vancouver, B. C.	
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario	
CHCC	Canadian Westinghouse Co., Ltd., Edmonton, Alberta	
CHCF	Radio Corporation of Winnipeg, Ltd., Winnipeg, Manitoba	
CHCQ	The Western Radio Co., Ltd.....Calgary, Alberta	
CHCS	London Radio Shoppe.....London, Ontario	
CHCX	B. L. Silver.....Montreal, Quebec	
CHCZ	The Globe Printing Co.....Toronto, Ontario	
CHFC	John Millen & Sons, Ltd... .....Toronto, Ontario	
CHIC	Canadian Westinghouse Co., Ltd....Hamilton, Ontario	
CHOC	Canadian Westinghouse Co., Ltd.....Vancouver, B. C.	
CHVC	Metropolitan Motors, Ltd.....Toronto, Ontario	
CHXC	J. R. Booth, Jr. .....Ottawa, Ontario	
CHYC	Northern Electric Co.....Montreal, Quebec	
CJBC	Dupuis Freres .....Montreal, Quebec	
CJCA	The Edmonton Journal, Ltd.....Edmonton, Alberta	
CJCB	James Gordon Bennett.....Nelson, British Columbia	
CJCD	T. Eaton Co., Ltd.....Toronto, Ontario	
CJCE	Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.	
CJCF	News Record, Ltd.....Kitchener, Ontario	
CJCG	Manitoba Free Press Co., Ltd....Winnipeg, Manitoba	
CJCH	The United Farmers of Ontario.....Toronto, Ontario	
CJCI	McLean, Holt & Co., Ltd....St. John, New Brunswick	
CJCN	Simons Agnew & Co.....Toronto, Ontario	
CJCS	Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia	
CJCY	Edmund Taylor .....Calgary, Alberta	
CJGC	London Free Press Printing Co., Ltd., London, Ontario	
CJNC	Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba	
CJSC	The Evening Telegram.....Toronto, Ontario	
CKAC	La Presse Publishing Co.....Montreal, Quebec	
CKCB	T. Eaton Co., Ltd.....Winnipeg, Manitoba	
CKCD	Vancouver Daily Province.....Vancouver, B. C.	
CKCE	Canadian Independent Telephone Co., Ltd., Toronto, Ontario	
CKCK	Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan	
CKCR	Jones Electric Radio Co., St. John, New Brunswick	
CKCS	The Bell Telephone Co. of Canada....Montreal, Quebec	
CKCZ	Canadian Westinghouse Co., Ltd.....Toronto, Ontario	
CKKC	Radio Equipment and Supply Co.....Toronto, Ontario	
CKOC	The Wentworth Radio Supply Co...Hamilton, Ontario	
CKQC	Radio Supply Co. of London.....London, Ontario	
CKZC	Salton Radio Engineering Co:....Winnipeg, Manitoba	

NEW APPLIANCES AND DEVICES

Proudfoot Vernier Condenser

IN the Proudfoot one knob vernier condenser, manufactured by the Cruver Manufacturing Company, the vernier plate lines up with the rotor plate as the knob is turned to the right so that the position of the vernier is always known when setting the position of the main plates and this is indicated by the large scale. The fine adjustment is obtained by turning the knob to the left which allows only the vernier plate to move and the position is indicated on



Vernier condenser

the inner scale, therefore by the two readings an accurate log can be obtained.

When using some circuits the movement of the vernier indicator one division will tune in or out a station so it will readily be seen how indispensable this very simple improvement of the condenser will be to the Radio Industry as a means of facilitating the reception of distant stations.

Post Metallic Soldering Iron

THE Post Electric Company now has ready for the trade a new product, known as the Metalectric Soldering Iron.

The Metalectric Soldering Iron is about one-half again the size of the Post soldering iron, but of somewhat different construction. It is constructed entirely of metal, thoroughly insulated and operates on any electric circuit in series with a regular light

Soldering iron

bulb, similar to the Post soldering iron. It is finished in a bright nickel and supplied with eight feet of cord wire including series current tap and attachment plug complete. The heating element is located in the point, which is fitted with an interchangeable tip, both point and tip being composed of German silver, insuring minimum oxidation and long life. The point itself is connected to the handle by a spring coil, allowing the operator to literally "get around corners" in intricate soldering both in radio and general assembly work.

The heating element is composed of nickel chromium, is large and durable. It has been subjected to exhaustive tests.

The Magnavox Company Announces New Models

AN announcement has been made by the Magnavox Company regarding the introduction of important additions to their line of reproducers and power amplifiers. Among these new models are the Magnavox combination sets A1-R and A2-R; a new Magnavox reproducer M1 and a new one-stage Magnavox power amplifier A1. The combination sets A1-R and A2-R (as illustrated) consist of the electro-dynamic Magnavox reproducer with 14-inch curvex horn and a Magnavox audio-frequency power amplifier (one or two stage) incorporated

Magnavox A1-R

in a new type of radio unit which might be termed an "Amplifying Reproducer."

The rheostats (maximum resistance thirty ohms) and circuits are so arranged in Magnavox combination sets that five-watt transmitting tubes or any type of amplifying tube

Power amplifier

may be successfully used, thus covering the widest possible range of operating conditions from the smallest home to the concert hall. These instruments are equipped with a modulating device for controlling the volume.

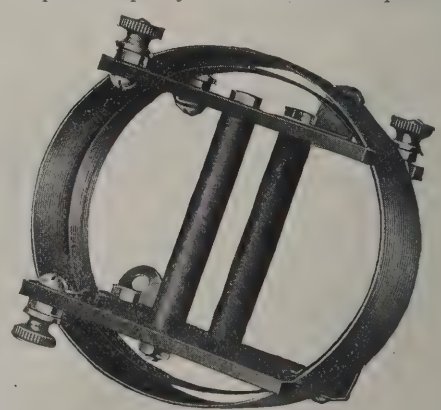
Another interesting and important Magnavox product is the M1 reproducer with 14-inch curvex horn. This instrument is of semi-dynamic type and has been developed

Magnavox A2-R

by Magnavox engineers along the original principle to meet the requirements of dry battery receiving sets, as it consumes no current from battery.

New York Coil Co. R. F. Transformers

THE new radio frequency transformers of the New York Coil Co. resemble nothing heretofore on the market, and are a complete departure from conventional practice. No "trick" circuit, delicate grid leaks or special capacity condensers are required



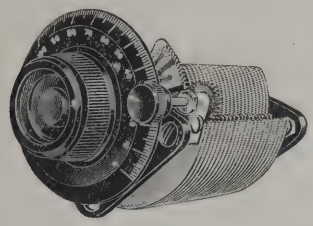
Radio frequency transformer

with these transformers and 201, 201A, or the 199 dry cell tubes may be used.

It is claimed that these transformers eliminate the heretofore experienced difficulties of radio frequency reception by originality of construction in electrical and mechanical principles. They are effective on wave lengths up to 550 meters.

Heath Radio and Electric Mfg. Co. Condensers

THE Heath Radio and Electric Mfg. Co. has incorporated several new ideas in variable condenser construction in their Radiant Condensers. The most vital feature of these condensers are the plates which the manufacturers claim cannot warp or buckle and are therefore permanently flat. To the ordinary processes of producing condenser plates they have added a special process of stamping the plates in extremely heavy presses which temper them to a degree of steel hardness. The Heath Radio and



Heath condenser

Electric Mfg. Co. say that this protects their plates from temperature changes and the accidents which bend ordinary condenser plates. The advantage of this feature, of course, is that as long as the adjustment of the plates is undisturbed the condenser will remain aligned almost indefinitely, thus solving one of the most aggravating problems associated with variable condensers.

Another feature is a vernier adjustment that operates on a reducing gear. Teeth on the outer edge of the vernier plates engage directly with the reducing gear. This enables ordinary vernier adjustment to be made infinitely finer. This adjustment has a separate tension take-up screw so that action can be maintained always positive and accurate.

New Crosley Model XJ

DURING the summer of 1923, the experimental department of the Crosley Manufacturing Company conducted a series of practical tests with radio apparatus and from these tests there was created the new Model XJ that is now an important factor in the new Crosley line of radio receiving sets.

This new Model XJ utilizes the famous Crosley tuned radio-frequency circuit. This is the same circuit which was used in the

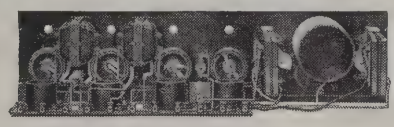
Crosley Model XJ radio receiver

Model X, the famous receiving set which made possible the hundreds of letters and telegrams from radio fans all over the country and especially from the static zones near Florida, where some of the owners of this model heard Honolulu several times. Except under the most adverse conditions, the owners of this model have heard stations from coast to coast. Now, however, comes the new Model XJ with its many refinements that will enable the owner to get even greater service.

Incorporated in the new Model XJ, is the Crosley multistat, with its molded shell rendering a smooth ball-bearing contact and graduated resistance wire to accommodate any type of tube, adding to the appearance and efficiency of the set. The new molded sockets of a composition approved by the best radio engineers and the new radio-frequency tuned amplifier coil with its unique low resistance winding makes it possible to tune out local interference, a thing the Model X has been noted for.

The new Model XJ is equipped with a phone jack, so that it is now possible to plug-in on one-stage of radio frequency, detector and one-stage of audio frequency for head phones. Removing the phone plug, automatically switches to the loud speaker binding posts, which is always connected from the rear.

A filament switch has been provided, so that the tubes can be turned off.



Interior view

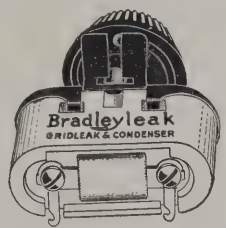
New knobs and dials have been provided and the large tuning knob is so grooved and designed, that vernier adjustment may be made with ease. These large dials and knobs are placed on the tuning condensers.

This new Model XJ is a four-tube set, consisting of one-stage of tuned radio frequency detector and two-stages of audio-frequency amplification. It is suitable for use with storage battery or dry-cell tubes.

Allen-Bradley "Bradleyleak"

THE Allen-Bradley Co., manufacturers of the Universal Bradleystat and Bradleyometer, have added another item to their line of graphite disc radio products.

The new device is an adjustable grid leak known as the "Bradleyleak," which was developed to meet the insistent demand for a high-grade, dependable grid leak.



The Bradleyleak can be adjusted between the limits of 250,000 ohms and 10,000,000 ohms or, as usually stated, between ¼ megohm and 10 megohms. The entire range of grid leak resistance between these limits is instantly obtainable without noises, steps or jumps by simply turning the adjusting knob.

The Bradleyleak is claimed to be very accurate and a desirable addition to any radio set and makes possible the accurate adjustment of grid leak resistance for any tube used on a detector circuit.

The base of the Bradleyleak is recessed to receive a small fixed condenser which is furnished as an extra attachment, if desired. The grid condenser is accurately adjusted to a capacity of 0.00025 microfarad.

New "Red Seal" Headset

A HEADSET designed to produce maximum results is the new "Red Seal" headset of the Manhattan Electrical Supply Company, Inc. Ohms were entirely neglected, but the impedance, matching that of the vacuum tube, is approximately 25,000 ohms at 1,000 cycles.

"Red Seal" headset

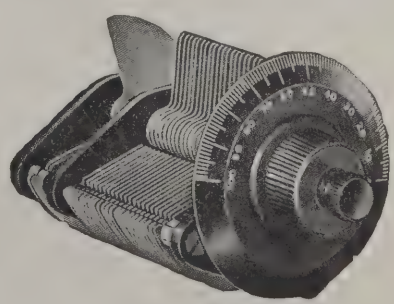
In addition to responding unusually well to weak signals, the Red Seal gives clear distinct response to strong ones. No "chattering" is possible, while the diaphragm is practically free from "periods."

Case and caps are of red bakelite. The headbands are covered with red moulded rubber, making the instrument very comfortable and easy to adjust.

U. S. Tool Co. Condensers

THE U. S. Tool Company has put on the market a line of variable condensers. It includes table mounting types as well as the plain and vernier types of all sizes and capacities.

The main shaft bearings are carefully machined, so that there is very little, or no wear despite years of use. Consequently there is no need of re-adjustment. The oxidizing of plates and spacers which ordinarily destroys the efficiency of most condensers is provided against by means of a special chemical treatment to which these parts are subjected. Even exposure to all kinds of weather has no effect upon these plates and spacers. This, alone, is a big step ahead in condenser manufacture. The insulating ends are of Condensite-Celeron. Although there has been endless discussion



U. S. Tool Co. condenser

of the special claims of the various materials used for condenser end plates, there is no doubt that Condensite-Celeron has the virtues of non-retention of moistures and extreme dielectric and tensile strength.

INDUSTRIAL INKLINGS

Holland as a Radio Market

ACCORDING to best estimates there are at present no less than 4,000 amateur receiving stations in Holland; following the war there were only a score or more receiving stations. The Management of Posts and Telegraphs advises that there are about 477 other receiving and transmitting wireless stations in the country.

Permits for receiving stations are readily granted in Holland. Dealers in radio materials are now negotiating with the Government for authority to erect a general broadcasting station. The plan is to broadcast concerts and news on a much larger and better scale than is done at present by any Netherlands broadcasting service to amateurs.

Germany has been getting the bulk of Holland's import business, but the greater portion of German goods coming into the country are old war stocks. These goods cost usually anywhere from 40 to 50 per cent. below American and other competitors in price. Germany, of course, has advantages in the Netherlands on account of proximity of market.

The United States is gaining a better foothold in this market, however, and imports of radio material are increasing. Whereas in the full year 1919 the United States sent only $1,600 worth of radio material to this market, during the first half of the year 1923 there were $12,800 (normal) worth entered.

American goods will probably continue to enter the country on an improved scale, and competent members of the business express the opinion that if American parts and systems were made to conform more to local needs a much larger business would be done. American instruments in this market are as a rule designed for wave lengths averaging around 360 meters. In Holland most radio owners desire around 1,050 meters average, and, in a good many cases, up to 2,000 meters is required.

Ready entry of radio material is provided for in Holland, since there are no Governmental regulations or restrictions governing imports. The import duty on parts and whole sets is 5 per cent. ad valorem.

Benjamin J. Cohen with Rova Radio Products Corp.

ON August 22, The Rova Radio Products Corporation formally introduced its new vice-president, Benjamin J. Cohen, in charge of sales, to the radio press at a dinner at the Hotel Pennsylvania, New York.

Mr. Cohen has been with the United Cigar Stores for twenty-one years, and his promise to the representatives of the radio press was, that his efforts would be directed toward the establishment of confidence between the public and his organization—service to the consumer, and assurance that his company would stand back of every dollar's worth of goods sold.

So far as entertainment at the dinner was concerned, Frank Tinney of the Music Box Revue, and Mrs. Tinney provided enough to satisfy the most exacting. No one had a better time than this fine team of entertainers, and they gave the crowd their best, and that is treat enough for one evening.

Broadcasting Helps Gas Sales

WHILE filling automobile tanks with gasoline this enterprising garage owner of New Haven, Conn., fills the air with speech and music by means of a loud speaker mounted outside the building. The innovation has proved to be very popular and has considerably increased the business of the filling station.

Radio loud-speaker used to stimulate gasoline service station business

THE interesting prize contest for windows trimmed to display to best advantage Cunningham vacuum tubes brought forth some notable displays for the week of September 24 to October 1.

The awards will consist of $5,000 in prizes to be distributed among 45 dealers having the best windows. The contest was limited to radio retail dealers who had Cunningham tubes in stock or who had ordered them at the time of the first announcement of the contest.

THE building in Tokio in which was located the headquarters of Takato & Co., also the main office of the Westinghouse Electric International Co., in Japan, was destroyed in the September earthquake. The building, of five stories, was a beautiful example of the architect's art and was one of the most modern business buildings in the city.

THE Eisemann Magneto Corporation has a new 24-page catalogue, "Radio Products," ready for distribution. It is of letterhead size, 8½x11, which makes it convenient for filing and contains a complete description of all Eisemann radio products which, as William N. Shaw, president, says in the foreword of the new booklet, "carry the full guarantee as to workmanship and quality."

New Sales Plan of Magnavox Co.

AN extension of the sales and advertising co-operation of the Magnavox Company has recently been announced and the new Magnavox selling plan has features which will prove of interest to all who are following the steady progress of radio.

In general the new plan consists in the appointment of Magnavox registered distributors whose combined influence covers the country; and also the appointing of registered Magnavox jobbers who supply the trade not directly reached by the Magnavox distributors' salesmen. The distributors are appointed directly by the Magnavox Company who in turn appoint the jobbers.

In addition registered Magnavox dealers are also being appointed, their selection being in the hands of the Magnavox distributors and jobbers.

The Magnavox promotion service is intended to link up the Magnavox wholesale and retail dealers with the extensive national advertising of the Magnavox Company and consists in supplying without charge a considerable quantity of efficient selling helps.

These selling helps include booklets, folders, leaflets, display cards, newspaper electros or mats, moving picture slides, giant reproductions of the Magnavox advertisements in the *Saturday Evening Post* and finally an extremely attractive Magnavox cutout lithographed in eight colors.

Each registered Magnavox dealer is furnished by the Magnavox Company with a registered dealer certificate in the form of a decalcomania for use on his window. Within a short time it is planned to register dealers in practically every community throughout the country where radio products are sold.

More efficient service to the radio consumer is the real objective in this selling plan and only such dealers are registered by the Magnavox Company as are qualified not only to carry the line in stock, but also to assist the purchaser in the selection and installation of radio equipment.

An important feature of this sales plan consists in reaching the wholesale and retail registered dealer at regular intervals by means of the Magnavox house organ which is devoted to assisting dealers in the efficient selection of display advertising and selling of Magnavox radio products, as well as to publish notices of interest to the radio trade.

THE H. H. Eby Manufacturing Company has ready for distribution their latest catalogue No. 15. This catalogue illustrates their complete lines of metal and insulated binding posts as well as other electrical specialties they manufacture. Copies of the catalogue will be sent free upon request.

Modern sales methods employed by live radio dealers include more than a mere display of apparatus

RCA window display of the McGraw Company, Sioux City, Iowa. "Tune 'em in quickly with a Radiola," is their slogan

RCA window display of the Shepard Stores, Boston, Mass. The Radiola enriches the home surroundings

Zenith Radio Corporation

THE Zenith Radio Corporation with a $500,000 capitalization all common stock with a par value of $10.00 has been incorporated and has the contract to act as the exclusive selling agents for Zenith radio receiving and sending apparatus, manufactured by the Chicago Radio Laboratory.

The officers and directors of the corporation are: E. F. McDonald, Jr., president and treasurer; Thomas M. Pletcher, vice-president; J. R. Cardwell, director; U. J. Herrmann, director; Irving R. Allen, director; N. A. Fegen, secretary, General Sales Manager; and S. I. Marks, assistant treasurer.

The Chicago Radio Laboratory is now enlarging its factory and manufacturing facilities to enable it to take care of an output of 300 sets per day. R. H. G. Mathews and K. E. Hassel of the Chicago Radio Laboratory are already busy with production of Zenith radio apparatus in period designs.

THROUGH the co-operation of the Wisconsin Radio Club there will be exhibited at the Fifth Annual Food, Household & Electrical Exposition, to be conducted by *The Milwaukee Journal* at the Milwaukee Auditorium, October 15 to 21, a complete radio broadcasting station for public inspection, and a series of educational exhibits, detailing the benefits of the use of radio in the home and on the farm.

The exhibits will occupy some 3,000 square feet of floor space and will be under the direction of the Wisconsin Radio Club which is composed of Milwaukee County radio dealers.

P. C. Kullman & Co., New York City, are sending out the fifth of a series of circulars designed to create a world-wide interest in radio. This latest circular has been mailed to officials-in-charge of wireless telegraphy and radio telephony in 112 foreign countries. It gives interesting information of radio development in the United States, including the following statistics:—

Trans-Oceanic Stations	12
Experimental Stations	292
Broadcasting Stations	591
Point-to-Point Commercial Stations	128
General Public Service Stations	41
Aeroplane Stations	2
Technical Training School Stations	128
Amateur (Licensed) Stations	18,357
Limited Public Point-to-Point Stations	40
Ship Stations (Estimated)	3,000
Receiving (Unlicensed) Stations (Estimated)	3,500,000

Readers of The Wireless Age can obtain copies of this and other interesting circulars on radio development by addressing Kullman and Co., 116 Nassau Street, New York.

Bureau of Standards Tests Receiving Sets

THE results of tests of radio receiving sets by the Bureau of Standards are given in a series of letter circulars of which the first (No. 90) was mentioned in item 9 of Technical News Bulletin No. 73. This paper dealt with tests of electron tube sets. The second circular of this series (No. 93) is now ready for distribution and gives the results of tests on crystal detector sets.

It is believed that the methods followed and the examples given in these reports will be of assistance to manufacturers in the development of methods of testing besides aiding them to properly describe and improve their products. The particular receiving sets are referred to by arbitrary reference numbers rather than by manufacturer's name and type and model numbers. As these circulars are only available in mimeographed form, the supply is limited, but copies can be obtained by those directly concerned with the testing of receiving sets by addressing the Bureau of Standards.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. All monthly lists of distant stations worked and heard which are received by the 10th of each month will be published in the next month's issue. For example, lists received by November 10th will be published in the December issue. Spark and C. W. stations should be arranged in separate groups.

8AEB, Don I. Barringer, Kalamazoo, Mich. (Sept.)

1aur,• 1gv, 1acu, 1bes, 1bji, 1ckp, 1cpi, 1cmp, 1cw, 1ckp.

2fp, 2sm, 2wb, 2agx, 2agb, 2amr, 2apd, 2aqq, 2bji, 2bnz, 2bsc, 2cfb, 2cqv, 2cqz.

3bp, 3ds, 3mk, 3mo, 3ni, 3th, 3tj, 3su, 3uj, 3tw, 3tb, 3vh, 3vd, 3wf, 3xn, 3ys, 3zt, 3afs, 3atg, 3bdo, 3bmo, 3bof, 3buy, 3bpm, 3cdn.

4ag, 4do, 4os, 4mb, 4gx, 4cs, 4kc, 4kf, 4er, 4om, 4ft, 4eb, 4rx (4uk ? qrm), 4my, 4ku, 4lj, 4ni, 4na, 4mi, 4gw.

5nj, 5pv, 5qh, 5ma, 5hl, 5ek, 5lr, 5ga, 5ny. 5za, 5kw, 5sg, 5uk, 5kc, 5am, 5fc, 5je, 5gi, 5sf, 5abt, 5aby, 5acm, 5akn, 5agg, 5amb.

Canadian 3bp, 3kg, 3ni, (9al?) (3wi? Also a large number of 8's and 9's were logged.

9ZT, D. C. WALLACE, Minneapolis, Minnesota. (Two weeks August over 1000 miles.)

CW. 1er, 1bbo, (1bcg), 1bes, 1bsj, (1bwj), (1crw), 2bnz, 2brc, 3ab, 3bv, 3iw, 3sg, 3brf, (3bva), (3chg), 4eb, 4gl, 5gj, 5gn, (5gp), 5nj, (5ns), (5sk), 5uc, 5uo, (5aba), (5acq), 5ajj, (5akn), 5amh, 5xab, (6hp), (6km), 6tv, 6arb, (6aru), (6awt), (6bjq), (6bvg), (6cbu), 7zn, (7agv).

Canada—2bn, mex, jh.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Guglielmo Marconi, *President* | J. Andrew White, *Acting President* | H. L. Welker, *Secretary*

Founded to promote the best interest of radio communication among wireless amateurs in America

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HEADQUARTERS: 326 BROADWAY, NEW YORK

ACCORDING to final reports from Australia, the following American amateur stations were heard there during the recent 8,000-mile trans-Pacific tests.

3ail, 3ard.

5me, 5no, 5aec, 5ado, 5bch.

6bp, 6bv, 6jd, 6ku, 6pd, 6avn, 6bic, 6bum, 6cbi, 6cdq, 6cgw, 6xad.

7au, 7la.

9gg, 9za, 9arl, 9auc.

In the case of some of these stations assigned code words were transmitted and the reception accordingly verified, but there is considerable doubt regarding the reported reception of a number of others.

Of the stations heard 6PD, San Francisco, Calif., was reported as being the strongest, the signals being consistently loud and clear.

A complete message was received from station 6JD, Los Angeles, and the signals of that station were reported as being audible at times twenty-five feet from the phones. The message received from 6JD is the first confirmed message ever received in Australia from an American amateur station. This same station is also reported as having been heard in Adelaide on a single tube receiver.

Conditions during the tests, especially at the receiving end, were poor. The whole country had suffered from a prolonged drought previous to the tests which was finally broken by heavy rainstorms which brought heavy static along with them. Other tests will probably be conducted this Fall.

THE first meeting of the Milwaukee Radio Amateurs' Club, Inc., following the annual Summer recess was held on Thursday evening, September 20th, at 8:00 P. M. in the Trustees' Room of the Milwaukee Public Museum. One week later the society, which is over six and a half years old and is now a non-stock corporation, held its annual corporate meeting at which there was an election of the members of the Board of Directors. The newly selected directors will appoint the five general officers and the committee chairmen.

At the several mid-summer meetings of the present directors extensive plans were formulated for a Fall membership campaign. Not only radio amateurs living in the City of Milwaukee will be invited to join the club, but all those residing in the city's suburbs and surrounding county. The club is primarily one for amateurs, but membership is open to others interested in radio, particularly to technically inclined broadcast listeners.

A lecture program is being arranged for. The committee in charge promises to present to the club during the course of the season some of the best known amateurs in the country as well as several men high in the commercial side of the radio field who have a known reputation as designers and manufacturers. Traffic discussions and means to reduce any local interference that there may be, will receive the attention of some gatherings of the members.

General co-operation with all other interests in the radio field will constitute the policy of the Milwaukee club. No great financial obligations are assumed by joining, and with a 100 per cent. representation of amateurs the association can act for all amateurs in any question involving their rights. The club's correspondence address is, 601 Enterprise Bldg., Milwaukee, Wis.

THE famous "zero," or unknown transmitting station of Paris, which has given the French authorities something to worry about for a long time, has at last been identified as one belonging to an American resident of the French capital, Reginald Gouraud.

The thrilling story of the mysterious "zero station" of Paris came to light when the young American, his experimental work completed, surrendered to the military authorities. His ingenuity and sense of humor, broadcast from his station, had amused France for months while the authorities were searching frantically to locate him.

Gouraud went to France to join the American ambulance unit during the war and remained after peace was declared. He began experimenting in radio with a spark set and a crystal detector. The set for both sending and receiving was developed by him more than a year ago. French law prohibits aliens from owning and operating radio sets, but that didn't bother Gouraud.

The trouble started one night when Gouraud determined to talk to the world despite the law. He tuned to the wavelength of Eiffel Tower broadcasting station, and after listening to a concert, suddenly broke in with, "Hello! Hello!" All listeners-in then heard some perfectly good English language. Then he started his phonograph and served out a program of lively jazz.

Military stations throughout France heard the first greeting with astonishment. The operators could not understand English, but understood the jazz. Gouraud signed off in French by saying, "We will have another concert tomorrow. Good night, ladies and gentlemen."

The next night it was the same. In a few days all the operators in France were listening while the American "kidded" them with his slang French and English and snappy jazz records. The police began a search and French newspapers took up the story of the mysterious station, which continued its illegal operation unhindered for a long time. Finally Gouraud surrendered to the French authorities, but was released upon promising that he would never again violate French radio laws.

THE signals of station 2BIR, D. A. Troy, Nutley, N. J., were recently heard by 6RR, Los Angeles, Calif. One five-watt tube is used at 2BIR.

△ △

AMATEURS and broadcast listeners throughout New Jersey reported a very welcome absence of odd noises while the trolley cars there were idle, owing to the strike.

△ △

E. R. BATEMAN, 418 Norman Avenue, Baltimore, Md., Call 3APT, reports the reception of signals and messages from the *Bowdoin,* call WNP, the ship of Explorer MacMillan, now in the Arctic on a long exploration of the polar regions. WNP has also been heard by George H. Pinney, South Manchester, Conn., 1CKP; Irving Vermilya, Marion, Mass., 1ZE; James A. Trainor of Dorchester, Mass., and R. B. Bourne of Chatham, Mass., since the ship left on its trip to the Far North.

Recent messages said that the *Bowdoin* was located at Etah, Northwest Greenland.

△ △

CONSTANCE LEE SHARP, 16 years old, of Alhambra, Calif., who has just been granted a first-class commercial radio license, is said to be the youngest member of the female sex to obtain a license of that grade.

△ △

JOHN LENOX, of 581 Perry Street, Trenton, N. J., while endeavoring to pick up WGY, ran across radiophone speech which proved to be a magazine article being read by an aviator into a transmitting set in an aeroplane high above the ground. The reader gave the call letters of the plane as DG-4, but neglected to say where it hailed from or where it was going and it has not as yet been identified.

LEON DELOY, of Nice, France, owner and operator of French Amateur station 8AB, the only French station to be heard in America during the tests of last winter, arrived unexpectedly in New York early in September for a visit with American amateurs.

Soon after reaching America, M. Deloy went to Hartford, Conn., and visited the offices of the American Radio Relay League.

M. Deloy is known to American amateurs because of his persistent efforts during the last year to establish two-way direct traffic with amateur stations in this country. He stated that he was confident of final success in the coming December amateur tests.

While in Hartford he visited the home of Hiram Percy Maxim, president of the league, and operated the latter's station 1AW, the first time that he has touched a key of an American transmitter.

Besides his interest in amateur radio, which he regards distinctly as a hobby, he is a sportsman of international reputation, being the champion live-pigeon shot of Europe.

* * *

THE Central High School Radio Club has been organized at Newark, N. J. Any boy student may become a junior member, but the requirements for senior membership embrace such things as ownership of a vacuum tube set, ability to read and draw diagrammatical hookups, and a satisfactory grade in examination on radio theory.

The faculty advisor of the club is David Skolnick, who is also vice president of the Faculty Radio Club. The recently elected officers are: Joseph Medresch, president; Herbert I. Diamond, vice president, and Hyman Marcus, secretary.

The vice president is chairman of the program committee, the other members of which are Robert DeCamp and Joseph Scilla. This committee has arranged many interesting talks to be given to the club, including talks by members of the faculty, members of the club and experienced amateurs.

Queries Answered

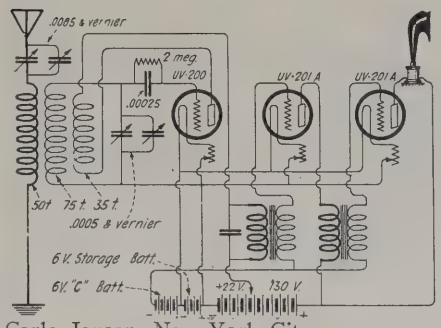
Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no questions answered by mail.

B. A. Smith, Watertown, N. Y.

Q. I would appreciate a little information in regard to the article of negative potential on vacuum tubes by Bernard Steinmetz, as written in the June issue of THE WIRELESS AGE. In the circuit employing the potentiometer across the "C" battery of grid circuit, would it not be necessary to use one of a certain resistance? If so, let me know just what I should use. I use a Reinartz. How would this work in it, or can you give me a hook-up which would be more selective for radiophone reception?

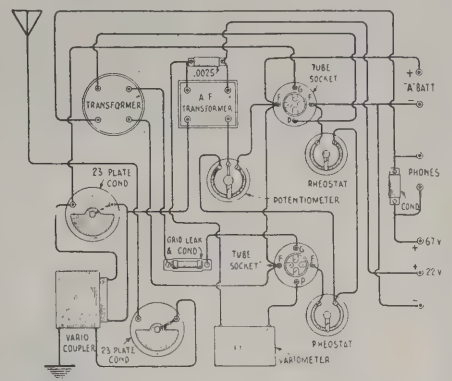
A. A Radio Corporation potentiometer, PR-536, of 200 ohms resistance is satisfactory. Here is a hook-up using three honeycomb coils which will be much more selective.

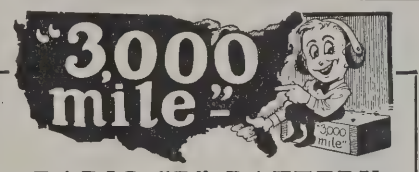


Carlo Janson, New York City.

Q. I have a single tube WD-11 set and I want to get a one-step amplifier. Therefore I bought another WD-11 tube, a socket, a rheostat, an amplifying transformer and a radio frequency transformer; but I do not know how to wire it.

A. The accompanying diagram is a good workable circuit for your purpose, and includes one step of reflex.





RADIO "B" BATTERY

DIRECT FROM FACTORY TO YOU — SHIPPED PREPAID

Greatest radio B battery on market. Absolutely fresh, full voltage, seamless cells, noiseless—will bring in Concerts **LOUDER** and **STRONGER!** Built correctly—full number of voltage taps—will work **any** tube or loud speaker. Real service **GUARANTEED.** Sold direct from our factories to you at lowest prices. Shipped prepaid to your door. ORDER TODAY. Send money order, check or pay C. O. D. Order By Number

No.5 22B—22½ volt variable—regularly $2.25—our price **$1.98**
No.5 22A—22½ volt variable—regularly $3.00—our price **$2.65**
No.5 45A—45 volt—8 taps—regularly $6.00—our price **$3.98**

AYRES BATTERY CORPORATION, Cincinnati, Ohio

Pall Mall Products

Hook Up and Description
of the famous ESSEX ONE TUBE COAST TO COAST CIRCUIT

FREE

to the first 1,000 fans who send in a 2c. stamp and the names and addresses of five friends who are interested in Radio.

ESSEX MFG. CO., 119 Mulberry St. Newark, N. J.

Jones' "Fiddlestick" Vernier

Drill one hole on side of each dial and make all fine adjustments with your hand away from set. Nicely finished in black enamel. Mounted 24 on a card for counter display.

10c **JONES' CONDENSER CLEANER** 10c

Pat. Applied For

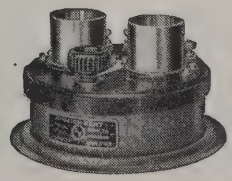
HERE IT IS

Clean those dusty, dirty condensers. Stop that noise every time you come to a certain spot. You will notice the difference at once. Mounted 24 on a card. Samples by mail 12c each. Samples free to recognized dealers and jobbers.

HOWARD B. JONES, 612 S. Canal St., Chicago

ATWATER KENT

RECEIVING SETS AND PARTS



If you are now working with a one-tube set, the 2-stage amplifier shown here will give you the necessary volume of sound to make a loud speaker possible.

It is a compact unit—transformers are sealed in the base so that no dampness can affect the working quality of the instrument. To demonstrate the damp-proof qualities, one of these instruments was soaked in a tub of water for several hours, then put into a circuit and tested for reception with perfect results.

Send for an illustrated folder showing all parts and complete sets.

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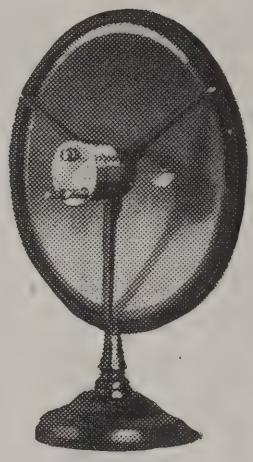

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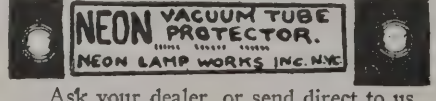
PRICE 50c 

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Lorin Mayhorn, Sebastopol, Calif.

Q. Can a Tesla high frequency coil, mentioned in Vol. III of "Homemade Electrical Apparatus" be operated on a toy 1102-volt step-down transformer? If so, how many volts should it take?

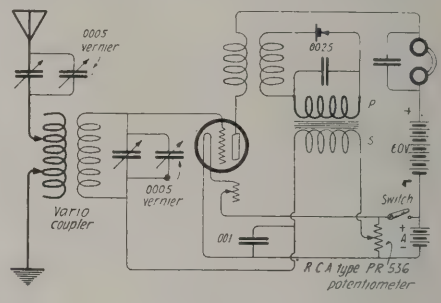
A. A Tesla coil cannot be operated from a step-down transformer.

* * *

Albert Montgomery, Greenleaf, Kans.

Q. 1. Would the hook-up of the reflex circuit, shown in figure 1 on page 61 in the May, 1923, issue of THE WIRELESS AGE, work more successfully coupled to an aerial and ground than a variocoupler? If so, will you please publish diagram?

A. 1. Below is circuit you request.



Q. 2. Please explain how the potentiometer is connected across the terminals of the "A" battery without drawing current from the battery all the time and overheating the potentiometer.

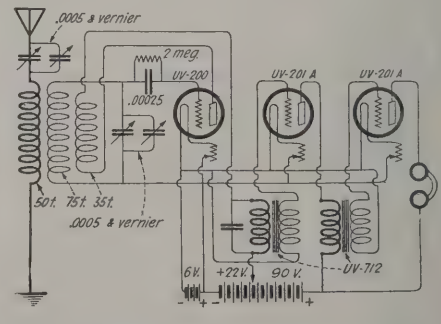
A. 2. The potentiometer has a resistance of 200 ohms and in the case of a 6-volt battery draws only 6/200 or 0.03 ampere. This current is insufficient to heat the potentiometer. In case dry cells are used for the "A" battery, it is best to connect a switch as shown, so that the batteries will not run down.

* * *

Edwin J. Israel, New York City.

Q. 1. Will you please be good enough to give me a circuit diagram of the Radiocraft Company's type D-6 outfit (Armstrong patent) showing also the capacity, etc., of the various condensers, coils, etc?

A. 1. Below is a circuit similar to the Radiocraft, using two stages of audio frequency.



Q. 2. I have been contemplating getting a Grebe RORN tuned R.F. amplifier to be used in conjunction with this set. Would this make a good combination insofar as better results in bringing in DX is concerned? Or would you recommend a radio

frequency amplifier of different make for better results with the D-6 mentioned?

A. 2. A Grebe type RORN radio frequency amplifier will give better results when used with the above circuit.

Q. 3. What tubes do you recommend using on the radio frequency amplifier?

A. 3. UV-201-A or C-301-A tubes are probably the best for radio frequency. UV-199's are the best dry battery tubes for radio frequency amplification.

Q. 4. If a radio frequency were used could the D-6 be used on an indoor loop aerial?

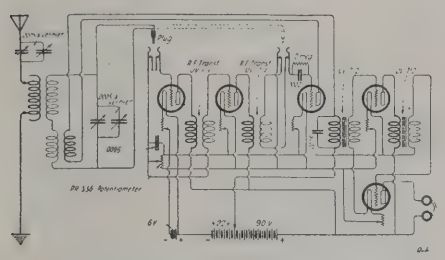
A. 4. An indoor antenna about 15 or 20 feet long, or a loop antenna may be used.

* * *

H. H. Ashbrook, Mitchell, Nebr.

Q. 1. Please publish the wiring diagram of the Colin B. Kennedy regenerative set, detector and two-step amplifier. Also diagram for two-stage radio frequency to work with same, using 201-A or 301-A tubes.

A. 1. Herewith is the circuit desired.



Q. 2. Which is the more efficient, tuned or untuned radio frequency?

A. 2. Tuned radio frequency is the more efficient.

Q. 3. Which is the simpler to handle?

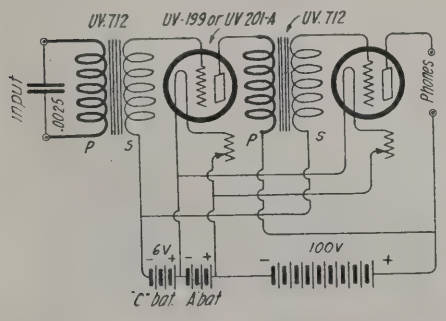
A. 3. Untuned radio frequency is easier to handle.

* * *

F. M. Adsit, Syracuse, N. Y.

Q. Please give me a hook-up of a two-stage amplifier to be used with the new Flewelling circuit.

A. The diagram is as follows:



Charles W. Lewis, Pawtucket, R. I.

Q. Above is my hook-up which I would like to improve with your help. When I built the detector I got KDKA about 600 miles and could not get any other station. I added one stage of amplification and got local stations with excellent results. Is it possible to make this a reflex? If so, what do I need? How do you wind a D.C. 50 coil?

A. You will find it hard to get distant stations in the Summertime. In the Fall and Winter your range will be very much greater. See other "Questions and Answers" in this issue for reflex hook-ups.

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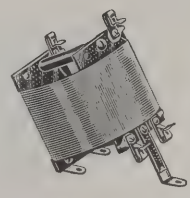

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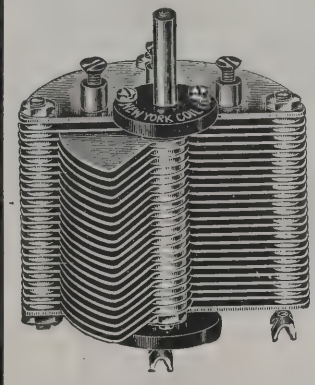

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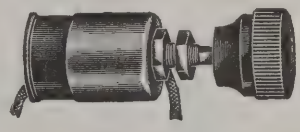

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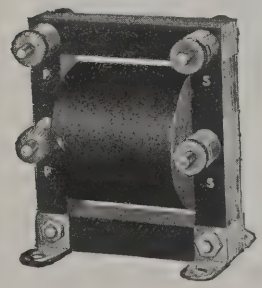

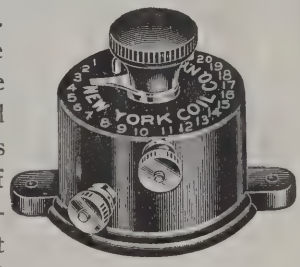

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Q. I would like to have some information regarding an article "A Supersensitive Receiving Set," by Charles R. Doty, published on page 84 of "Practical Amateur Wireless Stations." The information wanted is: Can a long range bank wound variocoupler be used in place of the loose coupler? Can the coils marked L and L-1 be bank wound so that a small length of tube could be used in place of the 30-inch tube?

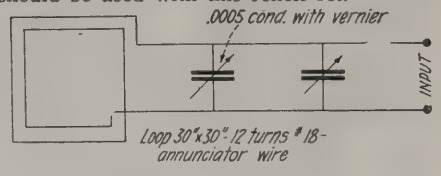
A. A bank wound variocoupler can be satisfactorily used in place of the loose coupler. The coils L and L-1 may also be bank wound.

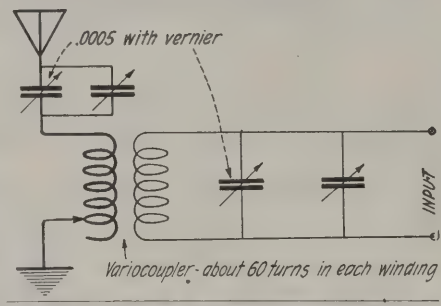
* * *

W. R. Van Dyck, West Philadelphia, Pa.

Q. Referring to "A New Reflex Circuit" on page 61 of the May issue, show the aerial and ground if used with outside aerial; or is loop absolutely best? Have WD-11 tube, also 199 tube.

A. Either a loop or a 2-circuit tuner should be used with this reflex set.





R. K. Temple, Lynchburg, Va.

Q. Kindly give a formula in THE WIRELESS AGE for the inductance of a choke coil having a core of Norway or Swedish iron wire or any iron wire of good quality.

A. Empiric formula for inductance of open iron core choke coil:

$$L = \frac{T2}{3140}\ (0.00042\ l + 0.00012S)$$

Where L=inductance in henries
T=number of turns
l=length of iron core in inches
S=area of cross section of iron core in square inches

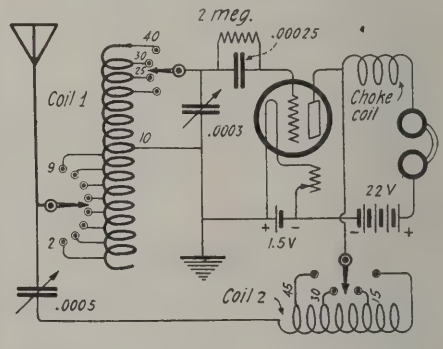
This formula is the result of many experimental observations.

* * *

Wm. C. Frindell, Pangman, Sask., Canada.

Q. 1. Will you please publish in THE WIRELESS AGE a hook-up of a Reinartz receiving set, showing details of the winding of the spider web coils?

A. 1. Below is diagram:



Either a spider web or a cylindrical coil may be used. The latter is to be preferred because of the simplicity of winding. Coils 1 and 2 are both wound in the same form. A spider web of 2½ inches inside diameter is used, with 9 spokes radiating; No. 26 S.C.C. wire is used. The plate winding, coil 2, is first started—45 turns are wound with taps at 0, 15, 30 and 45 turns. Coil 2 is then wound in the same direction, with taps at 2, 4, 5, 6, 7, 8, 9 turns—a ground tap at the tenth turn. Continuing, taps are taken at 25, 30, and 40 turns. The radio frequency choke coil in the plate circuit consists of about 300 turns of No. 29 or No. 26 S.C.C. wire wound on a tube 2½ or 3 inches in diameter—about 4 layers of 75 turns per layer. A 250-turn honeycomb or other machine wound coil is also satisfactory. A very thorough-going description of the Reinartz receiver is given in "Radio Telephony for Amateurs" by Ballentine, a Wireless Press book.

Q. 2. Will you also state if a wet primary battery could be used for lighting the filament of a peanut tube (Northern Electric R-125)?

A. 2. A wet primary battery is very good for such purpose.

* * *

Mr. W. T. Cobb, Jeanerette, La.

Q. I want to charge my 6-volt A battery from our lighting plant and just don't know how much resistance to use. We have a 110-volt direct current generator with sixty 2-volt cells for use when generator is not running. Can I use lamps in reducing the voltage? I wish to charge at about 5 amperes.

A. To charge your battery from 110-volt D.C. you will require a resistance of 22

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ohms which must be capable of safely carrying 5 amperes. If you wish to use lamps, you will require any one of the following combinations:

1. Six 100-watt lamps in parallel.
2. Twelve 50-watt lamps in parallel.
3. Ten 60-watt lamps in parallel.
4. Fifteen 40-watt lamps in parallel.

These may be carbon lamps since you do not care about the illumination. If you have a 500-watt electric iron you may use that as a series resistance instead of lamps. Be sure to allow for sufficient cooling in either case, whether you use lamps, resistances, or electric iron.

* * *

Arnold W. Miller, Laurium, Mich.

Q. Would you kindly furnish in THE WIRELESS AGE a suitable hook-up for charging a 70-volt B battery, using a 6-ampere Tungar bulb? What is the proper filament current of these tubes? Please note my hook-up and formula. Would the bulb stand that amount of current from filament to plate?

A. The filament of a 6-ampere Tungar bulb requires about 15 amperes at 3 volts. You will require approximately 25 turns for the filament. Because of the high filament current, this winding should be of low resistance. You should use two strands of No. 12 S.C.C. wire connected in parallel, or else use copper ribbon 3/8 inch wide x 1/32 inch thick.

* * *

Sam H. Wilson, Liberty, Mo.

Q. 1. Is, in your opinion, the "100-Mile Crystal Receiver" as described on page 76 of the December issue of THE WIRELESS AGE, a better, longer range and louder tone set than one made up of a Signal Jr. 600-meter loose coupler, condensers and crystal detector? I have one of the loose coupler sets on which I have heard Detroit, Chicago, Atlanta and Ft. Worth all on the same night and received them direct as no V.T. receiver is within five miles of here.

A. 1. We doubt whether you will be able to improve on your present reception with any other crystal receiver.

Q. 2. Of the one-tube circuits, Flewelling, Reinartz and super-regenerative, which gives the loudest amplification; which is the most selective; which is the easiest to tune; which, in your opinion, is the best for the concerts as will be broadcasted under the new rulings, and how do they compare in strength of tone with the three or four tube reflex receivers that are on the market now?

A. 2. Loudest amplification is obtained with the super-regenerative receiver. The Flewelling is not a super-regenerative cir-

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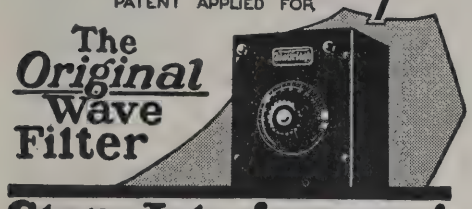

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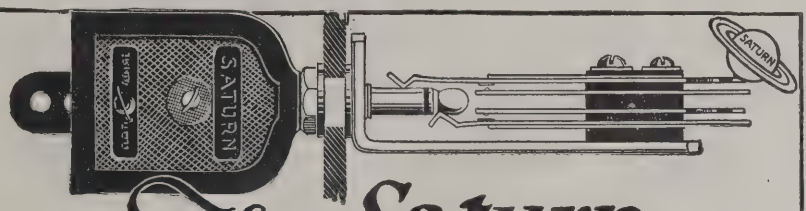

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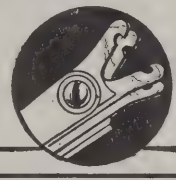

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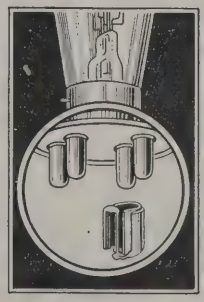

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cuit. If it were a true super-regenerator, you should be able to obtain loud speaker operation from a single tube. The Reinartz is the most selective, but the single-circuit receiver is sufficiently selective now that new wave lengths have been assigned to broadcast stations. The single circuit receiver, with two stages of audio amplification, will give satisfactory all around operation, both as regards selectivity, ease of tuning and loudness.

Q. 3. Is it possible to use the WD-11 or De Forest 3-volt dry cell tube (hard) in either of the three circuits mentioned above?

A. 3. You will find the new radiotron UV-199 much superior to either the De Forest or WD-12. The UV-199 takes 60 milliamperes filament current at 3 volts. It requires 90 volts on the plate with a 4.5 volt negative bias on the grid for best amplification.

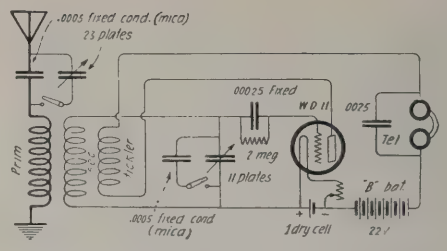
Paul Thomson, Elmwood, Conn.

Q. 1. Which gives the best regeneration, a variometer or tickler when connected between the plate and phones?

A. 1. A tickler is better since it is more effective over a wide wavelength range. The variometer will not give satisfactory regeneration above 450 meters.

Q. 2. Please give a regenerative hook-up, with data, for the following instruments: load coil, variometer, 23-plate condenser, 11-plate condenser, three fixed condensers, grid leak and grid condenser, WD-11 tube, rheostat, phones and batteries. I would like to be able to tune between 175 and 3,000 meters, if possible.

A. 2. We recommend using honeycomb or duolateral coils; using larger coils for the longer wavelengths. At the longer wavelengths it is advisable to shunt the tuning condensers with .0005 mfd. mica condensers.



The following coils are to be used at the various wavelength ranges:

Wavelength	Primary	Secondary	Tickler
150-350	35	35	35
300-700	75	75	35
600-1,600	100	150	75
800-1,900	200	200	100
1,300-3,000	300	300	150

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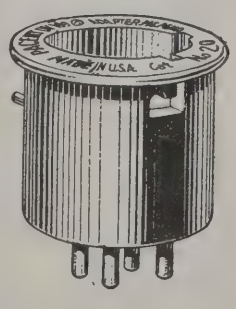

A thorough quality Pacent product. Contact and insulation perfect. Cannot short circuit. Satisfactory for radio frequency. At this price, the logical choice of all radio users. Catalog No. 20.

Send for Bulletin W-10 descriptive of above and other Pacent Radio Essentials

50c

Don't Improvise —"PACENTIZE"

PACENT ELECTRIC CO., Inc.
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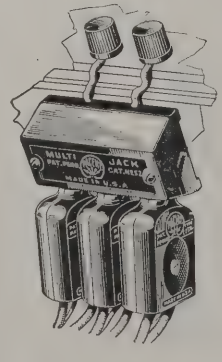

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Ask your dealer to demonstrate new No. 5240 Pacent Jackset—$1.50

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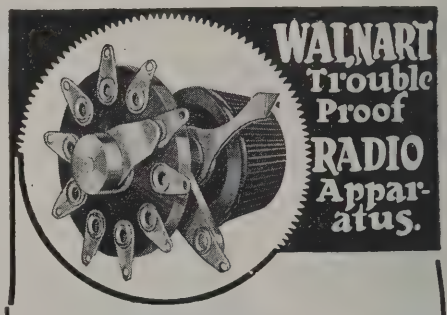
RADIO ESSENTIALS



DECORATE— Don't Mar Your Panel

No longer is it necessary to drill holes for switch points — by no means an easy job and hard to make attractive-looking.

Walnart's engineers have given the radio public the "Walnart" ten-point induction switch. Just one hole to drill. Saves time, does not destroy the panel, and can easily and quickly be fitted. The contact is smooth and positive. The knob is genuine Bakelite. The results will delight you.

"WALNART" Trouble Proof Variable Condensers

insure quick, accurate tuning. Plates are pressed and locked into supporting posts. Positive spring contact.

Plates	Plain	Vernier
3	$1.50	
5	1.65	
13	2.25	$4.25
23	3.00	5.00
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All above will be sent postpaid on receipt of price, but ask your dealer first.

This is one of the many Walnart specialties. Send for catalog of "Walnart" Trouble-proof Radio Products.

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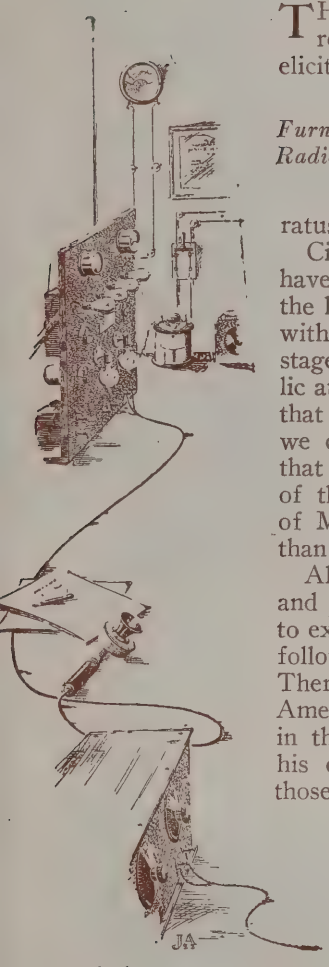
In Our Opinion



Furniture Radio

THE great progress in developing radio receivers as articles of furniture has elicited favorable comment from everybody who has seen these new models. Surely this can be counted the year's greatest single accomplishment in receiving apparatus for the home.

Circuits we have had, and many. We have seen them dash from the wings to the heralding trumpet of publicity, vying with one another for the center of the stage, and enjoying the limelight of public attention. But, as the impartial critics that we propose to be in this little sketch, we cannot resist the desire to say also that it has been observed that very few of these circuits held the rapt attention of Mr. and Mrs. Radio Public for more than three or four months.

All this is well, for radio is yet young, and promises to hold its romantic appeal to experimenters and the enthusiasts who follow their doings, for years to come. There is no tendency more typically American than the disposition of the man in the street to examine and verify, for his own satisfaction, the statements of those whose business it is to find things out for him. Ask almost any John Citizen why he drives the make car he does, and the chances are he will give you instantly a list of technical features of that particular motor which caused him to make the choice. The average American thrives on "reason why" copy in advertisements directed to him, because he is a human interrogation mark, hungry for facts and as much technical information as he can assimilate.

Granted that the impulse to make radio sets and experiment with various circuits is a symptom of a wholesome desire to learn, we submit that, when we seek to find the most important development work of the year, we must return to furniture radio.

It was not until the phonographs in cabinet models made their appearance on the market that this great invention was accorded a place in any great number of homes. It remained for Radio to meet the appearance requirements of the fair sex before it could gain entrance to thousands of family circles. All credit to the manufacturers, who have so successfully adapted incongruous radio sets to articles of furniture that lend decorative value to living rooms in the finest homes, while they reproduce the many delightful features of entertainment.

Now that the demand for embellished receiving sets has been so well satisfied by the makers, attention may again be directed to the improvement and simplification of the apparatus.

What the next year will bring forth is an interesting subject for speculation.

The Increase in Sport Interest

THERE'S no denying the fact that Radio has been the cause of a greatly extended interest in sporting events. Many's the man who, for some reason or other, never became really interested in sports, is now caught up and held alert by the vivid description and the contagious enthusiasm of the crowd, as the returns come over his radio set.

But it hasn't stopped at this by any means. We have observed staid old ladies, who never read a line of baseball news, hanging breathlessly onto the words of an announcer at the World's Series Games, and showing a ready ability at picking up enough points about the game to enable them to follow almost every word of description as it came from the loud speaker or headphone. More than once we have come upon whole family groups in tense, silent attentiveness listening to a colorful description of some boxing contest.

Almost everybody who reads this can multiply these experiences by a host more, from his or her observations.

Consider the extent of this awakened interest in sport throughout the country, and there will remain little room to doubt that radio broadcasting is doing more to further a public interest in sport than perhaps all other agencies put together. With the gospel of clean, healthy sport thus carried to every city, town and village, into every home that is equipped with a radio receiving set there must result a quickened appreciation for the rewards in health of all sports, and a keener desire on the part of everyone to engage more in these intensely interesting diversions that put color into cheeks and set the pulse pounding with the sheer joy and excitement of the games.

* * *

Radio and Thanksgiving

PERHAPS it has occurred to our readers that the first radio fan very probably came over in the Mayflower, in embryo: that the sturdy forebears who made the perilous voyage to this continent brought to the country the vigorous spirit of pioneering that serves us so well today in radio development. This was the flight of fancy that gave rise to the cover illustration for this issue: Pilgrim pioneers, the forerunners of radio!

Of course it was a long-drawn-out process, and the first definite radio tendencies were not evidenced as such until 1898, when some American experimenters were hard at it with Rumkorff coils that seldom "korffed" and coherers that just would not cohere.

How striking the contrast today, with nearly three million radio fans in the United States listening attentively to all manner of talks and entertainment, when they are not feeling the Pilgrim impulse to further pioneering by the process of tinkering and experiment.

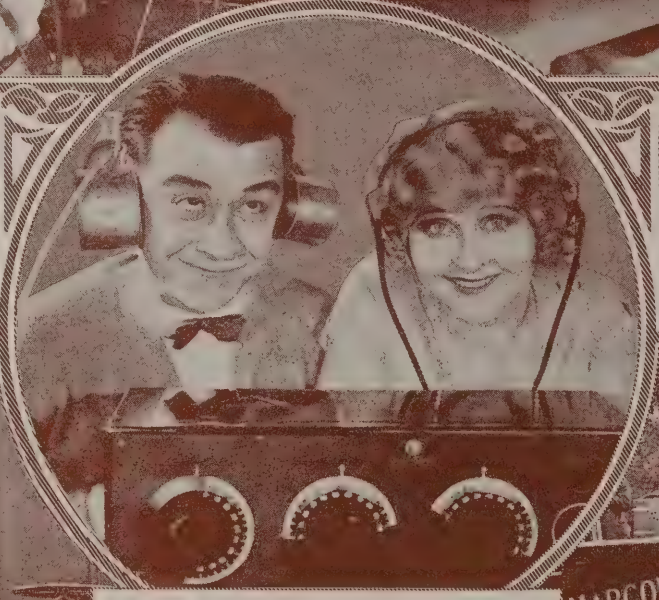
Well might we give thanks this month for such ancestors as these, whose spirit, passing down the generations, has supplied the healthy urge to that enterprise and pioneering endeavor which places America to the fore today in Radio, and many other fields.

—THE EDITOR.

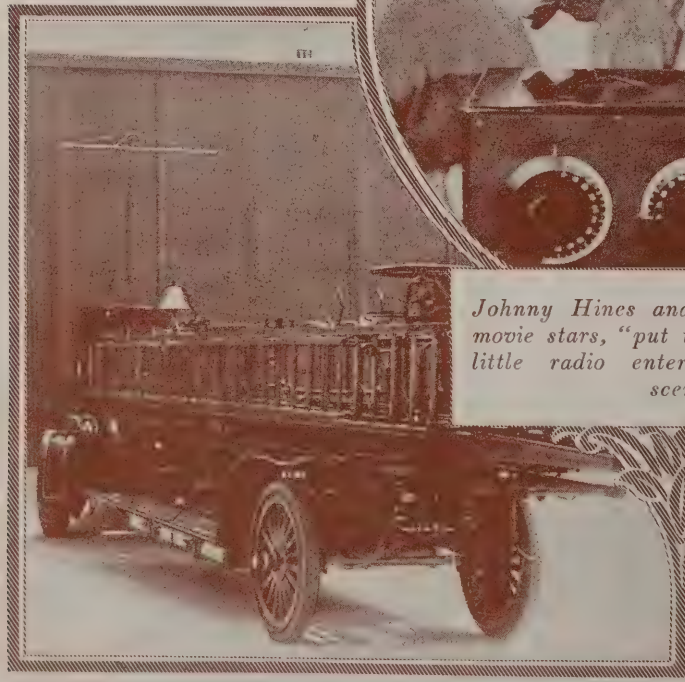
A Little o' This and That

A real treat is in store for the children on Christmas eve. It is planned now to have Santa Claus speak to the kiddies via the radio phone from the various broadcasting stations

"It's never too late to learn," said Mrs. Alta Stirt, who celebrated the event of her 110th birthday by becoming a radio fan. Photo shows her listening to her first radio concert



Johnny Hines and Hope Hampton, movie stars, "put the cans on" for a little radio entertainment between scenes



The fire ladder motor truck of U. S. Air Service at Crissey Field, San Francisco, California, is now equipped with a complete radio apparatus. Will we have this some day in all our large cities?

This is the way they "put over" a radio picnic in England. The loud speaker, of unusually large proportions, was ample for a gathering of several hundred people, at Burnham Beeches

Movie of a Man Who "Rolled His Own"

Bull Montana Joins the Ranks of the Fans

LET'S see now. It says "go over all connections, and be sure that the B battery wires don't get too familiar with the filament." Kinda deep stuff to me

GOOD night! Listen to it, will you! Sounds like a couple of hyenas being boiled in oil.

WELL at last I've got it so I can stand the phones on my ears. Can't seem to lose that funny sizzle though. Too much tickling, maybe

OH Boy! Here's a bird singing that one—"You gotta see mama every night um-te-dum"—Gee, I can hear it just as ***plain!***

The New York Radio Show

This miniature set was built by Sidney Kasindorf. It consists of two stages of radio frequency, detector and two audio

General J. G. Harbord, former deputy chief of staff, U. S. Army, now head of RCA, examines a captured German trench set

Loud speakers throughout the floor connected to microphone in picture helped to locate lost children at the radio show. The crowds were so great that many children were separated from their parents

Even the Japanese radio station was there, in a realistic model of the district in which this powerful station is located. This station was the only link with the outside world, for several days

More About the Show and Its Unique Exhibits

Here is the grandfather of the WD12 dry cell tubes, held by Miss Marjorie Allison. It made a very pretty sight, when lighted

This model of the Eiffel Tower was among the many novel amateur sets on exhibit

"I want to hear more of that last artist," said Miss Agnes Leonard. So she borrowed this receiver of heroic proportions

NOTE—See page 22 for story of New York Radio Show

New York's Big Radio Show

In Which We Express Our High-Spot Impressions of What We Saw at the Latest Gathering of Radio Bugs

As told by Austin C. Lescarboura

Mrs. D. Sarnoff
tuning in

WELL, folks, I've just returned from the big radio show held at the Grand Central Palace in New York, during the week of October 6th to 13th. And believe me, it was a real good show. Just now my head is buzzing with all kinds of new radio ideas and lots of radio enthusiasm. It may take weeks for the effects of this latest attack of radio fever to wear off. Nevertheless, while I am still in this delirium I am going to rave about the many interesting things I saw for your entertainment as well as benefit, I hope.

To be perfectly frank with you, I had been sort of fed up on radio shows. You know as well as I do that we have had too many of them. It seemed for a while that we had struck a veritable epidemic of radio shows until the public got tired of them and the radio manufacturers found the pace too strenuous and dropped out one by one. Finally, a group of safe and sane business men organized the American Radio Exposition Company for the purpose of giving us one real good radio show each year in New York City and San Francisco. They studied all the other radio shows, made careful note of their shortcomings as well as good points, called in the leading radio authorities and got their ideas and suggestions, and then set to work organizing a real good radio show.

The recent radio show represented the polished product of the American Radio Exposition Company. As I looked about the various corners of this show there came back to me a scene in the Bankers' Club room up on the roof of the Equitable Building in New York City, with a long banquet table surrounded by some twenty members of the radio four-hundred or whatever you wish to call the potentates in this game. Somehow or other I was invited to the affair. We all sat about, ate a bit, then talked, ate some more, then talked, ate some more, and still talked. We raked all former radio shows over the coals, said some pretty mean things about their management, gave our views of an ideal radio show, waxed eloquent over a Radio Week, set the date for the proposed radio show, and then passed the buck over to the American Radio Exposition Company in as graceful a manner as you could imagine. The result of all this was the radio show held during the Christmas season last year. Perhaps it was the unfortunate time selected; perhaps it was lack of appreciation on the part of the public; perhaps it was the fed-up condition of the public; perhaps—oh well, getting down to brass tacks, the thing fell more or less flat.

This Year's Show—A Different Story

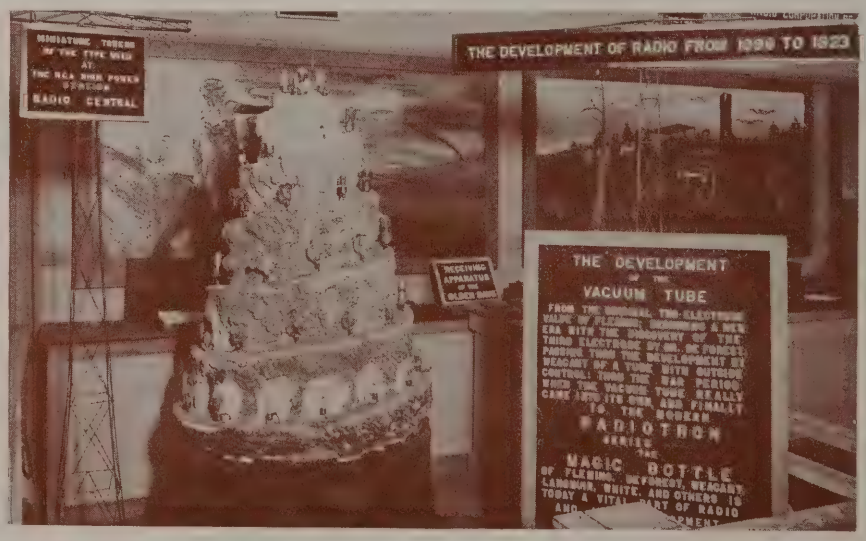
But with the present radio show we are dealing, all I can say is that it turned out a big success. All our ideas have been vindicated, and the promoters deserve unstinted praise for having stuck to their job. They have scored a big success at last. It now begins to look as though we shall have at least one real good radio show a year, to which we can all look forward. I have been strongly reminded of that memorable first radio show which we had on the roof of the Pennsylvania Hotel back in 1921, when the fire authorities and hotel management had to step in and turn back as many folks again as got into the place. I distinctly recall one stage of that great event when the crowd was so jammed full in the spacious roof garden that it no longer could circulate comfortably.

The recent show was staged on the fourth floor of the Grand Central Palace instead of the main or ground floor. There were large crowds during each day and evening, with Saturday's gathering topping them all for attendance. I understand that over 80,000 persons visited this show, yet at no time was the crowd so dense that free circulation was impeded. All of which speaks volumes of praise for the management.

The crowd, too, comes in for a word of praise. It was an interested crowd, rather than a bunch of curiosity seekers and mere catalogue grabbers. And how they could ask questions!

Still another word of praise, this time for the exhibitors. Many of them displayed real daring and originality, and it was quite obvious that real money was spent to make their booths attractive and distinct from the cut-and-dried formula of other shows.

To mention the more impressive exhibits in the order in which they made an impression on my mind, I must start off with the Radio Corporation of America, which followed its customary practice of striking the dominant note for the entire show, through its liberal display, size of space, educational features, and large corps of attendants ready to answer all questions and hand out attractive literature. It was made quite evident to all that RCA casts an all-covering mantle over the entire field of radio communication.



The pyramid of vacuum tubes, illustrating the development of the magic bottle of Fleming to the present day Radiotron, was an exhibit that everyone at the show had to see

The Army and Navy exhibit displayed many sets used in the World War as well as some foreign apparatus

Visitors were gently but firmly reminded that radio broadcasting is but one of the many activities of the RCA, and that the less fascinating but far more important businesses of transoceanic radio and marine radio must be carried on day by day.

The Japanese Earthquake Was There Too

Following the current of the moving crowd, I found myself in front of an interesting miniature Japanese landscape which, upon close examination, showed signs of earthquake devastation. In one corner rose the concrete stack-like tower of the great Iwaki radio station which, through the Radio Corporation stations, maintained communication with the United States during the recent trying days of the stricken Japanese nation, when the cables failed to perform.

Another educational feature of the RCA exhibit was an animated map of the world, showing the various kinds of stations and their locations. Onlookers were shown, by means of variegated lights, the number and distribution of broadcasting stations, the Navy stations, the RCA stations, and the stations abroad operating with the RCA stations. Here again we were struck with the cold fact that there are other uses for radio aside from broadcasting daily programs.

I rather doubt that another educational exhibit got the attention to which it was justly entitled. Here I have in mind a revolving display in the form of a mountain, with a winding path leading up to the summit. Along this winding path were mounted vacuum tubes, beginning with the crude lamps with which Edison discovered the so-called Edison effect, then the early Fleming valves, the De Forest audions, the early three-element tubes, and finally, at the very summit, the present well-known members of the radiotron family. What a review of vacuum tube history! I was held hard and fast for at least a quarter of an hour by this display.

And Now "Furniture Radio"

So far as radio equipment is concerned, there was one undeniable fact which hit me smack between the eyes; the trend toward "furniture radio." Yes, sir; radio receiving sets are making way here and there for these "furniture radios" which are as much at home in the living room of any home as the pianola and the console phonograph. No longer will it be necessary for Friend Husband to keep the radio receiving set in some obscure corner of the home, there to be heard but not seen.

Listening-in on the largest ear-phone at the show

Following the example set by the Radiola Grand and the Radiola IV, other similar radio instruments have appeared. I could not help but admire the beautiful workmanship of such exhibitors as Amrad, Crosley, Moon, and Colin B. Kennedy. "Furniture radio" is exceptionally attractive, being available in period furniture styles to harmonize with any given home surroundings. By the way, be sure to pronounce this name as though it were written "Coal-in." I was severely reprimanded by one of Mr. Kennedy's lieutenants for pronouncing it as though it were written as Collin. What's in a name!

However Mr. Kennedy may like to have his name pronounced, I am glad to see him and the rest of the boys get on the band wagon so far as "furniture radio" is concerned. This trend is a happy one indeed, for it is aimed at The Woman. At last we fellows are beginning to realize that Milady is the main "poobah" of the home and controls the family exchequer, even unto radio. She has some very definite views as to just what she will permit to invade the sacred premises of the living room. We have finally taken a leaf from the automobile manufacturer's notebook, in recognizing the feminine appeal.

Circuits for the Tired Business Man

Circuits, did you say? Oh yes, that's important, too. One had his pick at this show. There were something more than the fifty-seven varieties to select from, ranging all the way from the standard RCA single-circuit tuner to Sleeper's one-thousand-and-one circuits. I gathered from my visits to many "parts" manu-

facturers' booths that a goodly portion of the crowd were out to "roll their own," so to speak. My visits to the booths of "set" manufacturers, on the other hand, conveyed the positive impression that more and more broadcast listeners were buying complete receiving sets, especially that national figure, Mr. Tired Business Man. And why not? After all, the average radio broadcast listener is simply out to get the programs. Whether he receives them on a flivver single-cylinder roustabout or a DeLuxe twelve-cylinder limousine makes little or no difference. The service is the thing, first, last and always. Of course I will admit that Mr. Tired Business Man and other broadcast listeners start with a single-tube outfit and wind up with the finest "furniture radio" set money will buy. Indeed, it is this steady evolution, more than any other single factor, that keeps radio manufacturers busy and removes all fear of a saturation point in radio merchandising.

As for brand new ideas in sets, I came across the CR-13, which is intended at this particular moment for the dyed-in-the-wool radio bug engaged in dot-dash work on the usual amateur wave lengths, but must ultimately come into its own when once the broadcasters get down to low wave lengths so as to reduce still further the possibilities of interference. Al Grebe's sets continue to be characterized by the well-known Grebe workmanship and finish.

Another surprise was the Radiola VII. This latest addition to the Radiola family consists of a neat cabinet-type receiving set which, in general appearance, somewhat resembles the Radiola IV, and which contains radio-frequency and audio-frequency amplification. It is entirely self-contained except for the loud-speaker. I was told that this set performs remarkably well on a small loop, with its UV-199 tubes and dry cells.

There were many other sets laying claim to distinct novelty. On the one hand it was evident that the effort behind the set was towards simplicity, to interest the broadcast listener, while on the other the effort was decidedly towards greater efficiency irrespective of the multiplicity of controls and tubes. My impression was that the loop type of receiver, which figured so prominently in previous radio shows, was losing in favor with radio manufacturers, and in its place we were getting tuned radio frequency receiving sets, working in conjunction with very small antennas.

Loud Speakers That Were Not Heard

Of loud-speakers, I had my fill. To me they represent a most interesting phase of radio broadcasting. Often have I cussed one of those blamed things squawking in front of a radio shop, turning away person after person from ever bothering with radio except, possibly, after a long and tedious educational campaign waged by ingenious publicity and aided by the informal and sincere demonstrations of friends possessing radio sets. Fortunately—or unfortunately, whichever way you feel about it—these loud-speakers could be seen, examined, but not heard. The management of the radio show had laid down the law to the effect that no loud-speakers were to be operated except those installed

This immense loud speaker which is a stock model of the manufacturer attracted considerable attention at the show

for the common cause. My curiosity was aroused as regards the loud-speakers of RCA, Geraco, Bristol, Amplitone, Murdock, and other makes, not forgetting the new Brandes Table Talker which represents a novel departure for that pioneer manufacturer-specialist of famous radio head sets.

Of course the show would not have been complete without radio literature. Tons upon tons of literature were passed out to extended and grasping hands. That was the gratis stuff, you know. And it didn't stop at catalogues. No indeed; for many of the radio magazines and newspapers were liberal with their sample copies—so much so that we may look for some welcomed increases in their November circulation reports. At this point I want to register a little word for the radio periodicals. They are improving steadily. In editorial contents as well as in advertising clientele, they are showing healthy signs of growth and marked stability of character. More power to them!

Periodicals depend on advertising for their financial success. Every schoolboy knows that fact by now. It is no mystery, I am sure. Hence my compliment to the periodicals must be accompanied by one to advertisers. So here goes: radio advertisers, you are doing a good job. You are supporting the radio press in their good work. You are doing a great job for the radio public. And the fact that many of you have been advertising year after year has not only served to establish you, individually, in the minds of the radio public, but it has served in a most unselfish way to lend a touch of true stability and permanence to the radio industry as a whole. It has helped in no uncertain terms to offset the destructive influence of the radio fakers, charlatans and "gyp" artists—the parasites of radio.

"By the Radio Club of America"

No doubt the most altruistic service performed at this great show was that of the Radio Club of America in furnishing the musical entertainment by means of a battery of loud-speakers distributed throughout the large space. In the Club's booth, giving part of his time to an elaborate loop receiving set and the other part to answering a volley of questions aimed at him from all sides, I found that arch priest of the radio broadcasting cult—Major Edwin H. Armstrong. Inventor of the regenerative circuit and other phases of present-day radio work, Armstrong, an ardent member and worker of the Radio Club of America, installed and operated his latest type of super-receiving set which, by means of a small loop, intercepted the broadcasted programs of stations both near and far and boosted their signals up by means of elaborate power amplifiers so that they might be heard and enjoyed by all. The Major saw to it that his super-regenerative set especially built for the occasion hit on all seven—not cylinders, please understand, but tubes, UV-199's. I, as a member of the Radio Club of America, got in behind the scenes. Under the table on which the set was placed I discovered dozen upon dozen of standard dry cells. There must have been well over a hundred of these cells supplying a steady flow of current to the loud-speakers which filled the large hall with excellent music. The reception and rendition were positively the finest I have ever heard—and I have a pretty critical musical ear at that.

In the same booth with the Major stood George Burghard, President of the Radio Club of America, John Grinan, John Stanley, Ernest Amy, and others. Everything was done to entertain the visitors, and also to get

(*Continued on page 28*)

Reporting Baseball Series to Millions

Radio Stretches Diamond Over U. S. and Fills Phantom Grandstand With 2,000,000 Excited Fans

By Raymond Francis Yates

"HE'S winding up. Here it comes. He hits it! It's going into center field. He's safe on first."

A million loud speakers from Seattle to Philadelphia, from Ottawa to Mobile, echoed this thrilling description of the World's Series and held countless baseball radio fans in breathless suspense. It was one of those radio events that causes the blood to tingle in the veins with its many tense moments and dashing realism. The broadcasting of the recent world series will long stand out as one of the greatest heart-bumping events of American sport. It made the game bigger; it made it mean more to hundreds of thousands of sport lovers. The game was not confined to the Polo Grounds or to the Yankee Stadium, but like a great wave, its attending excitement and enthusiasm poured over the country to again blare forth from the husky throats of a million horns.

J. Andrew White broadcasting the World's Series through WJZ and the score board used to follow the plays

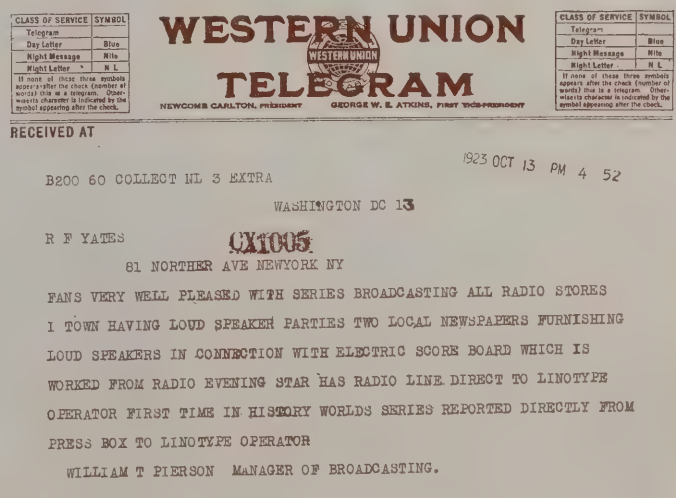
The cheering, the yelling, the usual stream of fan advice to the players; the booing and hat-throwing was not all done by the eye spectators for at thousands of street corners, public buildings, parks and theatres, to say nothing of countless homes, the fans held their sway. So rapid was the radio fire that the fans in Washington, Philadelphia, Baltimore, Detroit, Cleveland, Chicago, Kansas City, San Francisco and other big cities yelled in almost perfect synchronism with those at the Polo Grounds or the Yankee Stadium. What mighty cheers must have gone up and what a mighty thing radio is to bring about this perfect unison in a country so large as our own!

Behind the Scenes

Baseball is a national sport, but this is perhaps the first time that a world series has been a really successful national event. Heretofore the newspaper was the first harbinger of victory or defeat. Now a living voice back of the home plate describing every detail of the action in split-second style is able to reach the ear of every sport lover who cares to listen in.

Those who listened-in probably never dreamed of the elaborate preparations that were made necessary to handle an event of this magnitude. It was not merely a matter of leasing a Western Union wire that would connect WJZ with its outposts. That is a simple matter, but not so with the negotiations that have to be conducted with the "powers that be." So important was this matter that the actual approach for permission to broadcast was made during the middle of last summer. Nor were Messrs. Huggins and McGraw, the respective managers of the Yankees and Giants, the only "pebbles on the beach." The final request for permission had to be carried to the high and mighty Judge Landis himself, and since there was "no appeal beyond Caesar," those who did the presenting anxiously awaited the fateful answer. The answer was fateful because there was opposition from the direction of the Baseball Sport Writers' Association, whose members thought that radio would interfere with the sale of the evening papers that carry the work of their faithful scribes. The gray-haired judge overruled their objection and gave to WJZ and WEAF the right to broadcast.

A few days before the opening game of the series, trial communication was established between WJZ and the Yankee Stadium, using the leased wires of the Western Union Company. Major J. Andrew White, who is probably the greatest word-picture painter of sporting events today, was the first to employ the new portable amplifier built in the laboratories of the Radio Corporation of America especially for sporting events. With the aid of J. O. Smith, White's silent partner, the entire thing was rehearsed with care. White used a special diamond which was always held in front of him and manipulated by Smith, who worked with the speed of a one-armed paper hanger in an effort to check up White and to keep him informed. It is generally believed that Smith follows only radio as a hobby. Ah, but he is a versatile hobbyist. He not only owns and operates one of the best ama-



CLASS OF SERVICE / SYMBOL
Telegram
Day Letter — Blue
Night Message — Nite
Night Letter — N L
If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

WESTERN UNION
TELEGRAM
NEWCOMB CARLTON, PRESIDENT — GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

RECEIVED AT

1923 OCT 13 PM 4 52

B200 60 COLLECT NL 3 EXTRA

WASHINGTON DC 13

R F YATES CX1005

81 NORTHER AVE NEWYORK NY

FANS VERY WELL PLEASED WITH SERIES BROADCASTING ALL RADIO STORES I TOWN HAVING LOUD SPEAKER PARTIES TWO LOCAL NEWSPAPERS FURNISHING LOUD SPEAKERS IN CONNECTION WITH ELECTRIC SCORE BOARD WHICH IS WORKED FROM RADIO EVENING STAR HAS RADIO LINE DIRECT TO LINOTYPE OPERATOR FIRST TIME IN HISTORY WORLDS SERIES REPORTED DIRECTLY FROM PRESS BOX TO LINOTYPE OPERATOR

WILLIAM T PIERSON MANAGER OF BROADCASTING.

One of the many telegrams sent to express appreciation of the baseball broadcasting. Note the reference to the direct contact by radio between reporter and linotype operator for news publishing

Mr. E. F. Grossman on duty at the WEAF station in the Polo Grounds

teur radio stations in the United States, but has a keen eye for beauty in motor boats as well, and what is more interesting, he is an ardent baseball fan with the name of every record player on the end of his tongue. Consequently White and Smith are an admirable team and they work together like Siamese Twins. White announces with his eyes on Smith's hands while the latter shifts little pieces of cardboard labelled with the player's names around the diamond.

How 2,000,000 Fans Are Served

This matter of announcing is serious business. Imagine yourself sitting there amidst the roaring crowd of 75,000 people, responsible for an accurate account of every detail to perhaps 2,000,000 people! You can't guess. You've got to be right. Every emergency must be prepared for, every play recorded with the pitiless consistency of a mathematical process.

It is 1:45 P. M. eastern standard time. The game is on! White clutches his microphone, all tension, while Smith sits on the edge of his chair with his little pasteboards ready to be swung into place as the action of the game calls for them. Countless ears await the first word.

"Witt is up," White calls out. "Scott's winding up. He is about to throw. Here it comes. It's a called strike." There is not a moment of silence. "Witt is waiting for second pitch. Scott's winding up. He is going to throw. Here it comes. He hits it. It's going over second. Witt safe on first." Smith checks up White instantly and moves his little pasteboard marked "Witt" over to first base. It is all done in the twinkling of an eye, but the men in the broadcasting box must be on their toes every instant and they work under a mental strain that is little appreciated by the listener-in. As this article is written White has been responsible for only one error and that was corrected almost immediately, due to Smith's watchful eye. There is every opportunity to make a mistake, however. Imagine, if you will, a hot grounder driven between first and second base. The shortstop and the second baseman are after it and they almost collide. How easy it would be to pick up the wrong man and to say that Ward had it instead of Johnson.

Input apparatus and the special microphone used by Major White in broadcasting the World's Series for WJZ

There were many features of White's broadcasting that brought out the picture of the game so clearly that practically every fan who listened-in was a spectator. In one radio sport party, of which the writer was a member, a listener said, "I can 'see' great with White." This was just the situation. White was simply allowing about 2,000,000 baseball-radio fans to use his eyes—he painted word pictures that other minds could feast upon. So accurate were his descriptions that anyone who had ever attended a game at the Polo Grounds could visualize the plays perfectly. Very little imagination was required for this, especially when White turned his microphone on the roaring, booing or cheering crowd. These little inserts of realism transplanted the atmosphere of the diamond to every nook and corner of the United States. At all other times the external noises were excluded as much as possible and the special microphone used permitted the speaker to exercise considerable control over this feature.

Radio Reporting Now a Science

Those who listened to J. Andrew White could not help but admire his painstaking attention to the details, side lights and human interest stuff that permitted every listener to be one of the excited fans in the grand stand. Every ball pitched was described as being high or low, inside or out. This made it possible to even anticipate the withdrawal of a pitcher, for every good fan could tell when he was weakening. Such was the case with Shawkey in the eighth inning of the fourth game. So it was with Bush, who weakened in the seventh inning of the fifth game. A seasoned fan could see it coming, for Bush had pitched six straight balls before he was signalled off the field. When the ball lit in the grand stand the listeners knew whether it was a male or female who got it; whether they caught it or fumbled it. When the Bambino restlessly kicked up a little dirt while standing on third, the picture came out of the loud speaker. With all these little humanisms and a little imagination you were seated comfortably in one of the first row boxes at the Polo Grounds or Yankee Stadium.

A wonderful bit of announcing was also done by McGeehan of WEAF. While White's voice was only modulating the transmitter of WJZ, McGeehan's was used for four different equipments, WEAF, WGY, WCAP and WJAR. It goes without saying that McGeehan was also responsible to an enormous audience. His clear voice, his close attention to detail and his apparent knowledge of the game kept all of his listeners well informed at every minute.

An "SOS" Call Between Innings

There were many high lights during the series. One of them came between the third and fourth inning of the fourth game, when the voice of the radio reporters suddenly left the air while the studios broke in and told the audience that a short intermission was necessary because of SOS signals that were on the air. The writer instantly retuned his equipment in time to get the tail end of an SOS call, which was answered by some "op" who was going too fast for a rank ham to read. However, the world series was back on the air in a few moments and the game went serenely on.

Those who listened intently could probably hear the incessant clicking of the telegraph instruments in the background. The writer mentions this because it helps to form an amusing reminiscence. What a slow, snail-like thing the telegraph is when compared to the speech-carrying radio wave? Yet what a horribly important thing these clumsy little clickers were two or three years ago when the fans in distant cities had to depend upon them for the results of the games! The telegraph operators at the series had only sufficient chance to start the first word before those listening on the radio had the complete details of the play.

To prove that the radio broadcasting of the world series was really a tremendous event, national in scope, the writer dispatched eleven wires to some of the principal broadcasting stations in the country asking what success was being had in this work and inquiring about the interest and enthusiasm of the fan listeners. In every instance return wires were received telling of the great success of the series and of the good that it was doing radio in general. The writer quotes from a typical telegram from WJAR in Providence.

"Public address system furnished by the American Telephone & Telegraph Company drew a crowd of 3500 to Garnet side of our store. Cheering eminent during the entire announcements keeping the crowd well keyed. Enthusiasm running high. Receiving many personal replies from listeners as to fine way in which series is being put over."

Another answer from WCAP, Washington, brought more interesting news. William J. Pierson, Manager of WCAP said that practically every radio store in town had loud speaker parties and that two of the local newspapers were furnishing the loud speaker to gatherings in connection with electric score board.

Loud speaker outfit installed in an auto outside the Stadium reported the games to overflow crowds

The Evening Star did a very practical and original thing when a direct radio line was run from the receiving set to a linotype operator, and we have for the first time in history the direct transmission of the world series from the press box to the linotype operator. This means that a play made in one instant is a few seconds later immortalized in the form of a hot slug, waiting to be gathered up and taken to the press room. Here is an innovation that radio made possible. Just another instance of how we find it wedging itself into our daily existence from practically every angle.

What is radio doing for the sport of baseball? Is it making us too lazy to go to the games or is it injecting new life into it? Fortunately we have facts and figures that show that radio has brought about a healthy revival of interest in the game. It is to be noted that there were plenty of seats left on the Polo Grounds a few years ago, but since the first series was broadcasted both the Polo Grounds and the Stadium, although the latter has the largest seating capacity of any baseball field in the world and the former has been greatly enlarged, have been unable to accommodate the crowds that sought their gates. The writer has many friends who had sort of lost interest in it until they heard one of the series reported by radio which brought back to them the old thrills and the intense desire to see at least one of the games. It goes without saying that there have been a lot of tickets sold on this account, and it looks as though it was up to the radio fans to claim this victory for it.

Input equipment installed at the Yankee Stadium with E. F. Grossman at left and A. W. Protzmann standing, who operated the input apparatus, and at right Graham McNamee, who described four of the games for WEAF, WGY and WJAR

Radio Is Making Us a Nation of Sport Lovers

Other high lights were added to the broadcasting of each game when White produced famous sport writers and sport leaders to say a few words to the fans. Grantland Rice, that polished veteran of the sporting page, gave a most interesting talk on the psychology of players. Fred Lieb, President of the American Baseball Writers Association followed up at the beginning of the second game with some baseball facts that had never before been brought to the attention of the fans. In fact, Lieb was so interested himself in addressing the radio audience that he overstepped his time

limit and entirely forgot that the game had started. Other talks by men like Johnny Dundee, Bozeman Bulger, Hugh Fullerton and Christie Mathewson kept the baseball fever running high among the listeners.

There is another highly interesting detail that the writer would like to comment upon before putting the cover on his typewriter. Even the most casual listener was able to hear the players hit the ball and sometimes the characteristic "plunk" of the pill could be heard as it embedded itself in the cavity of the catcher's mitt. The sound of the hitting was particularly interesting because the nature of the sound allowed one to tell whether or not it was a good solid strike. When the ball was ticked, the sound in the loud speaker lacked that fullness that a well struck ball hit fairly in the center and with full force would give. By thorough attention to this detail one could often anticipate White's announcements. Again and again after a good solid crack he would announce that a two-bagger had been made. When Ruth and Stengel made their home runs every fan in the country must have known that the ball was on a long, long journey before White had a chance to announce it in his microphone.

The writer has but to wish that THE WIRELESS AGE would increase its size by 10 pages so that he might continue to tell all the interesting things that took place during the broadcasting of the series. They are not important things, but they are interesting. Take for instance, the odd requests that the announcers at the games receive. Not one of the games passed without fifty or a hundred people coming to the announcer and asking him to mention their name for the benefit of friends at home. Some fond father would come forward and ask White or McGeehan to please tell little Johnny, who is listening in with a $2.00 crystal set, that Daddy is safely at the game. Of course this would have been an important bit of news for the 2,000,000 odd listeners, to say nothing of the intense aggravation that Johnny would have experienced with Daddy at the game and himself at home with Baby Sister. Then too, both the announcers had to be careful that theatrical press agents who always swarm such events do not succeed in "putting over" one of their classy little tricks. They tried again and again but White's and McGeehan's vigilance successfully prevented them from getting a single event across. In all of the mad scramble for publicity and mention over the radio, not one woman presented herself. Every request was received from a man. What's this about vanity? Probably the real curse of radio is that it will make men more vain.

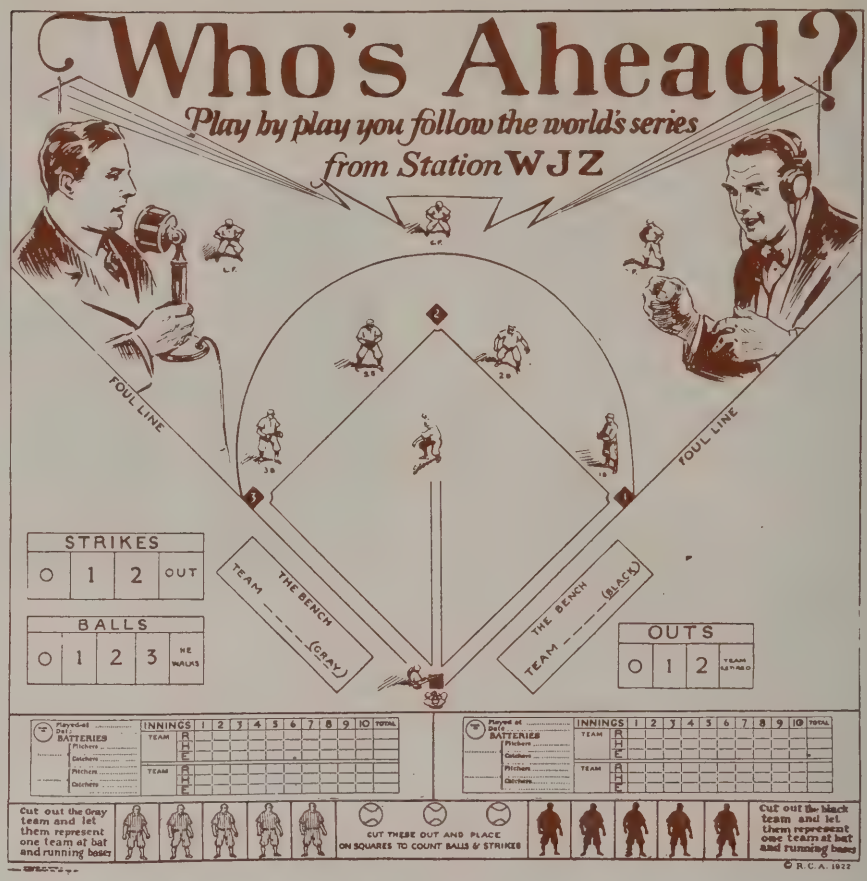

Who's Ahead?
Play by play you follow the world's series from Station WJZ
FOUL LINE
FOUL LINE
STRIKES
0 1 2 OUT
BALLS
0 1 2 3 HE WALKS
OUTS
0 1 2
THE BENCH TEAM ---- (GRAY)
THE BENCH TEAM ---- (BLACK)
INNINGS 1 2 3 4 5 6 7 8 9 10 TOTAL
BATTERIES
Pitchers
Catchers
Cut out the Gray team and let them represent one team at bat and running bases
CUT THESE OUT AND PLACE ON SQUARES TO COUNT BALLS & STRIKES
Cut out the black team and let them represent one team at bat and running bases
© R.C.A. 1922

Diagram of the baseball score card sent out to broadcast fans to help them follow the description of the game

And this is the end of the story of the broadcasting of the world series by radio. It will be a long remembered affair in the minds of baseball-radio fans especially in the inaccessible parts of the United States. It brought to them news of the game that might otherwise have taken days to reach them. It is almost useless to rave wildly over the greatness of radio. The thing is so big that words lose their meaning when one attempts to point out its benefits to civilization, but it does go without saying that when White and McGeehan spoke their last word in the last game every baseball-radio fan in the United States voted radio one of the greatest forces in the world today.

New York's Big Radio Show

(*Continued from page 24*)

before them the salient facts about the Club in the form of a leaflet with membership application blank attached.

MAJOR ARMSTRONG IN A NEW RÔLE

In parenthesis, I might add at this point that Major Armstrong, the originator of so many important developments in radio broadcasting, has recently sprung another radio surprise. Darned if he hasn't tuned in the call letters of Miss Esther McInnis, the fair secretary of commercial radio's big man, David Sarnoff—yes, sir; taken this fair lady's hand for matrimonial purposes this fall!

Are you a member of the Radio Club of America? If not, you should be a member of that pioneer organization. In view of the growing popularity of radio broadcasting, it has widened its scope to take in broadcast listeners. The advantages derived through membership are well worth while. Obey the impulse—now. Mail your application to Mr. George Burghard, 10 Warren Street, New York City.

A picturesque feature of the show was the "amateurs-who-build-their-own contest." The various entries were exhibited to the critical public gaze. Some of them were quite presentable, while others were really awfully crude. One which caught my eye was made in the form of the famous Eiffel Tower, with three hinged inductance coils as the only visible radio feature. The first prize of $50.00 went to Oliver Parker, the second prize of $25.00 went to Joseph Dorothy and the third prize, $15.00, to Frank Adams.

Well, folks, there is lots more to tell about that wonderful radio show but my space is up and I am signing off. Good day!

Large Scale Rural Radio

Nation-Wide Campaign to Develop Radio in Rural Sections for Practical Purposes

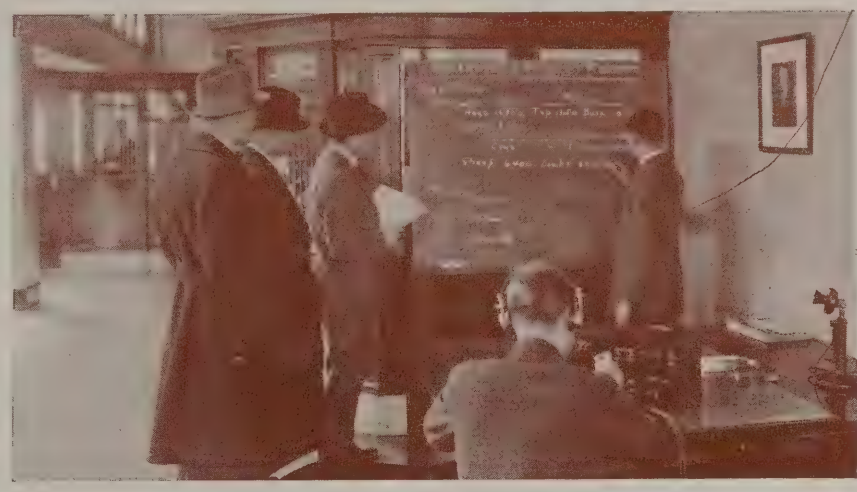
By J. Farrell

WHEN the city goes to the country these Summers it encounters a new experience. The country store, the proverbial meeting ground for the exchange of local news and gossip, is a deserted place. But up the street, in the country bank, the crowd will be found—grouped around a Twentieth Century Pandora's box more wonderful than the Greeks ever imagined.

Journeying anywhere throughout the land one is struck by the lead that country banks have taken in the use of radio. Here and there a local editor or merchant will be found who has been quick to grasp the opportunity afforded, but by and large it is generally the country banker to whom credit is due for breaking the barriers of isolation.

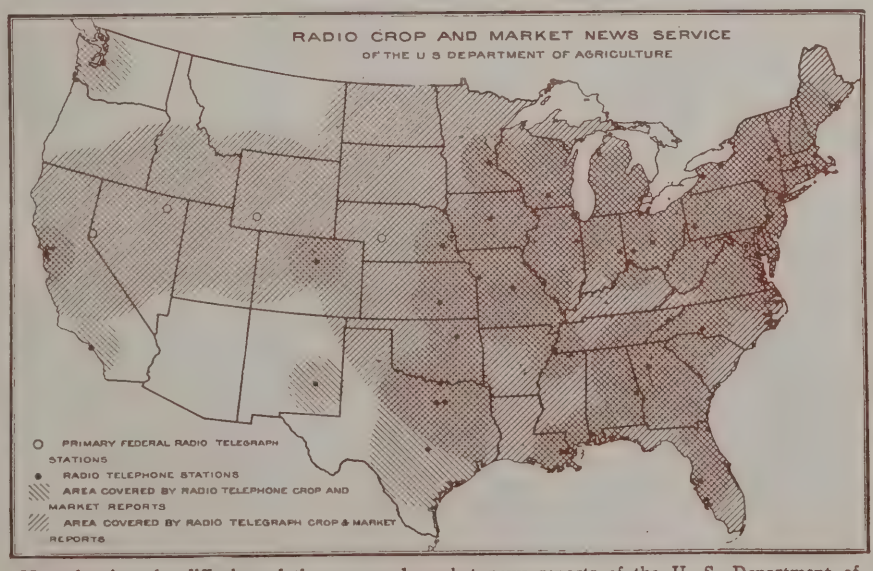
At Raymond, Ill., in the heart of an important grain and live stock country I talked with C. McNaughton, cashier of the First National Bank. The general offices of the bank had the appearance of a miniature stock exchange. At one end of the room a clerk was busily recording price and news bulletins on a large blackboard. In front of the board there was a miscellaneous group of farmers and local business men.

"Each morning the grain buyers, stock buyers and farmers call to learn the quotations and to compare notes," Mr. McNaughton told me. "They are all strong for the service. Heretofore they had to depend on the commission houses and country branches for commercial news. The service was not altogether satisfactory. Price discrepancies were frequently disclosed and the farmers could never be certain that the news was accurate. The information was often delayed and by the time the farmers entered their trades anything may have happened to the market.



Any morning at the bank, where flows the radio stream of farm market quotations

"But now," Mr. McNaughton expanded, "the folks hereabouts get accurate quotations almost as fast as they occur. Particularly to the grain and live stock dealers this has frequently prevented considerable money losses through enabling them to enter buying or selling orders as the market might indicate. Another feature is that the service brings people in closer contact with the bank."


RADIO CROP AND MARKET NEWS SERVICE
OF THE U S DEPARTMENT OF AGRICULTURE
PRIMARY FEDERAL RADIO TELEGRAPH STATIONS
RADIO TELEPHONE STATIONS
AREA COVERED BY RADIO TELEPHONE CROP AND MARKET REPORTS
AREA COVERED BY RADIO TELEGRAPH CROP & MARKET REPORTS

Map showing the diffusion of the crop and market news reports of the U. S. Department of Agriculture

Mr. McNaughton mentioned numerous other banks in the state that furnish similar service to local people. The First National Bank at Albion, Ill., recently installed radio equipment to receive grain and live stock reports. At Carthage, Ill., the cashier of the Dime Savings Bank said that the farmers were hungry for more news. Inoculated with the radio speed bug, they wanted the news even faster. They were particularly interested in the opening and closing quotations. More than 250 places throughout the state where market news is received were listed for use. Many of these were the homes of individual persons, but business houses in towns that have installed public service, banks and grain elevators easily took the lead.

In Missouri, Illinois, Nebraska, Ohio and Iowa I visited more than two score banks which maintained a daily radio news service for the convenience of their customers. They included farmers' banks, trust companies, and savings banks. R. D. Bower, assistant treasurer of the Caldwell County Trust Company at Kingston, Mo., stated that it is the "best service we have ever had of getting prices. I hardly know how we could get along without it. The majority of the banks are using this just the same as we are." The cashier of the Farmers' Bank at Stephens, Mo., said the service was especially valuable as "we did not have access to any means of receiving the markets other than by newspapers, and newspaper markets are always a day late when they reachthe rural districts."

This use of radio in country banks

is serious business. In the city the radio may be used largely for entertainment, but in the rural places the use centers around the reception of political, social and business news. In many communities it has become the habit of certain groups to congregate wherever the reports are received at the hours fixed for the reception of the different kinds of information. First may come the live stock men to hear what happened at Chicago, Kansas City, Omaha, and the other big live stock markets that morning. Then the folks interested in overnight political and social developments all over the world. Follow then the grain people who want to know the opening prices on the various boards of trade. The general stock market quotations draw many listeners.

Everywhere it is the same story. At first the radio in rural communities was regarded as a novelty, but it is now becoming more and more an indispensable utility.

"When rural mail delivery was first established, most farmers were suspicious of it," one farmer told me. "They thought it was some new political propaganda. But now they depend on the system very much. It has been the same way with radio. The price of first-class radio sets is the only thing that holds them back. They're waiting for prices to go lower. Meantime they are making use of the services established in town in the banks and stores."

A movement is now being considered by state and Federal authorities for a nation-wide campaign to develop radio in rural territories on a really large scale. It is proposed to have the 2,000 or more county agricultural agents throughout the country to give visual demonstrations of radio to farmers, and to establish so-called radio reception centers all over the counties they cover. The aim is to place at least 500,000 radio receiving sets in farm homes. A feature of the campaign will be the giving of radio demonstrations at the state and county fairs. Such demonstrations on a single fair circuit last Summer were viewed by more than 4,000,000 people. An effort is to be made also to induce an increasing number of banks and stores to establish public receiving stations where farmers and others interested may come and get the latest commercial news.

Radio Reports as Well as Predicts Weather

U. S. Weather Bureau Has Used Radio Since 1905 and Is Expanding Its Wireless Network Continually

PROBABLY few people realize that the work of the U. S. Weather Bureau is dependent on prompt receipt of weather reports from observers over as wide an area as possible. It is from the comparison and charting of conditions that forecasts are made, the charts revealing the location of storm centers, and experience indicating their probable direction of movement. Radio telegraphy for years has played an increasingly important part in the communication systems upon which the Weather Bureau depends; in fact, the January, 1923, issue of the "Monthly Weather Review," published by the Bureau and issued in April, devotes nine pages to a "History of Radio in Relation to the Work of the Weather Bureau."

According to this article, "The first radiogram received by the Weather Bureau containing a weather observation taken on a ship in the Atlantic was from the S. S. *New York,* on December 3, 1905, in latitude 40° N., longitude 60° W. It was the result of arrangements made with the Marconi Telegraph Co. to receive at its station at Siasconset, on Nantucket Island, messages containing weather reports from passenger vessels plying between New York and European ports that were equipped with wireless apparatus. Few reports were received from ships in 1905 and 1906, but sufficient to indicate the great value of and necessity for such observations in forecast work. . . .

"Daily or twice daily observations now are secured by telegraph and cable from about 240 stations in the United States and Canada (210 in the United States and 30 in Canada), from 17 places in Mexico, 20 points in the West Indies, 12 Alaskan stations, and 22 European cities. These are supplemented by reports obtained wholly or in part by radio from 16 places in the West Indies and Central America; 5 in Alaska; from Honolulu, Guam, and Midway Island, in the Pacific; the Philippines, China, Japan in the Far East, and from 36 places in Europe and the Arctic regions, including the Azores, Greenland, Iceland, Spitzbergen, and Jan Mayen. . . .

"On July 15, 1913, the broadcasting of daily weather bulletins was begun from the naval radio station at Arlington, Va., and Key West, Fla. The bulletins were broadcast at 10 p. m. and in two parts. The first part consisted of code letters and figures showing barometric pressures, wind direction and force at 8 p. m., 75th meridian time, at 8 places on the Atlantic and Gulf coasts and at Bermuda. The second part contained special forecasts of winds along the north, middle, and south Atlantic and the Gulf coasts a hundred miles or so offshore. Storm and hurricane warnings were included whenever issued. . . .

"The first systematic radiophone broadcasts of forecasts were made from the station operated by the University of Wisconsin beginning with January 3, 1921. Prior to that date and since October 1, 1916, broadcasts had been made therefrom by radiotelegraph. The next radiophone forecast distribution service was inaugurated on April 26, 1921, by the St. Louis (Mo.) University. This was the first station to disseminate river forecasts by this means.

"On July 1, 1921, 12 radiophone stations in 7 States were broadcasting weather information, daily forecasts, river forecasts, crop information, cold-wave, frost, and other warnings. Since that time the work has been rapidly extended, and at the present time 140 radiotelephone stations in 39 States are engaged."

French Artists Demand Pay

AFTER several months of co-operation with the broadcasting stations in the Eiffel Tower and in the suburbs of Paris, certain French musicians have decided that no longer will they permit their concerts to be broadcast without payment. The Paris Orchestra, for instance, now refuses flatly to allow its concerts to be broadcast, and the Union of Dramatic and Lyric Artists and the Syndicate of Musicians have both instructed their singers and instrumentalists not to allow the broadcasters to transmit their efforts. Part of the difficulty is understood to have been occasioned by the fact that various restaurants and dance halls in Paris have discharged their musicians and instead have installed radio receivers. Just how the situation will end no one knows, but since the French government grants subsidies to the Comédie-Française, it is to be presumed that at least the artists thus subsidized will be more or less freely available for French broadcasting.

Time Signals Tell Where You Are

How Surveyors Use Arlington Time in Laying Out Boundary Lines—Automatic Recorder Developed for Use by U. S. Coast and Geodetic Survey

By S. R. Winters

THE determination of longitude and latitude by radio sounds technical and abstruse yet it affects every man who owns land, for all surveys are based on such data alone. The position of any point or points on the earth's surface can be accurately indicated only by reference to the lines of longitude and latitude, which are determined by observation of the exact time at which any one of several stars, or even the sun, cross the meridian or exact central line of the sky.

It is easy enough to use a surveyor's transit for observing the star; the error, if any, occurs in the chronometer that marks the time. Hence the importance of securing absolutely accurate time when in the field for surveying purposes, and hence the great value of the radio time signals to property owners.

Automatic apparatus for not only receiving these signals but recording them on paper has been developed, and recently was tried out in the vicinity of Wisconsin Rapids, Wis., where it automatically recorded time signals sent from the Naval Observatory in Washington, D. C. The Coast and Geodetic Survey of the United States Department of Commerce contemplates widespread application of this ingenious mechanism in recording time signals, and may even use it in the determination of differences of longitude in Alaska.

The new wireless instrument was designed and built by Dr. E. A. Eckhardt and Dr. J. C. Karcher of the Bureau of Standards, United States Department of Commerce, and before it was transferred to the Coast and Geodetic Survey, radio-telegraph signals from Lyons, France, 3,800 miles away, were automatically copied on a sheet of paper wound around a cylinder. Before being turned over to the service of the surveying branch of the Federal Government, the apparatus remained at the Naval Observatory for one month. Here, the lag in recording radio-telegraph time signals was determined.

This retardation represents the interval of time between the tick of the master clock buried under the Naval Observatory and its record on the chronograph or time-measuring instrument used by the surveying crew afield. The time signal first passes through the telegraph relays at the Naval Observatory, going by land-line telegraph to Annapolis or Radio, Virginia, to the gang relays at this wireless station of the United States Navy Department. Thence the electric impulse passes through the receiving antenna, and out through the transmitting antenna, relays, and pen magnets to the pen record of the chronograph sheet. Hence, an allowance for the time taken by the electrical impulse in going through this complicated circuit must be applied to all longitude determinations made by radio telegraph. This correction, once determined, remains constant.

From the Naval Observatory, the surveying crew of the Coast and Geodetic Survey, under the direction of Lieutenant Fred E. Joekel, proceeded to Marshfield, Wis., in which state the first field tests were made. The initial experiment was carried out in the neighborhood of Wisconsin Rapids, and the party in charge of the expedition reported to the Washington office of the Coast and Geodetic Survey, "The results obtained were very satisfactory."

The time signals received from the Naval Observatory, via the wireless transmitting station at Arlington, and copied by this automatic radio recorder for use in conjunction with longitudinal determinations, were employed also in obtaining the rates of error of the gravity chronometers or time-measuring devices. Subsequently, latitude observations were made at Wisconsin Rapids, as well as at Owen, a point between Wisconsin Rapids and the next longitude station. Two three-quarter-ton motor trucks are used in transporting the surveying crew, wireless receiving apparatus, and surveying instruments. Where it is only necessary to make longitudinal observations, the automatic wireless recorder and auxiliary equipment can be installed in a very brief period of time. However, in the event that longitude, latitude and gravity reckonings are to be made, one and one-half days are required to set up the apparatus. This novel method of determining the differences in longitude and latitude is also being applied to surveys in Kansas, as a result of the success of the instrument in Wisconsin.

The radio receiving set used is a single-tube regenerative tuner, with some special adaptations that make

(*Continued on page 39*)

Making the time signals write themselves down—the new automatic radio time recorder with its designers, Dr. J. C. Karcher and Dr. E. A. Eckhardt, of the U. S. Bureau of Standards

Philip Gordon

Radio's Relation to Classical Music

Philip Gordon

Interviewed by Edwin Hall

WHAT is radio's relation to classical music? Is it merely an adjunct to the concert platform? Or has it a new sphere all its own? That is a question that has puzzled many broadcasting program managers, who have wondered whether to concentrate on jazz and the lighter type of music, or whether perhaps a little "highbrow stuff" now and then should be included for the benefit of a very few in the listening audience.

Philip Gordon thinks that the radio broadcasting station has a definite duty to both classical music and to the audience. It has the double duty of presenting that music carefully and understandingly, so that it will be enjoyed by those who already love it, and be appreciated by those who may be hearing it for the first time.

It was out of this conviction that Mr. Gordon's Monday evening lectures on Musical Appreciation grew. Started first as an experiment, to gratify his desire to try the idea out, the Monday evening talks from WOR have grown to be a fixture. "Every once in a while," said Mr. Gordon, "I decide that it takes a great deal of my time, and that I shall stop. Then I get a letter that shows me how much these talks mean to someone, and I continue."

He is a busy man. He is head of the music department of the South Side High School in Newark, N. J., and teaches a great deal outside of school hours. There are many other things that he could do with the time he has been giving to the radio audiences, yet they have been so appreciative, and have shown so well that they are getting new insights into music through his talks that he has continued them far beyond his original idea.

He began with two talks on "How Music Is Composed," in which Mr. Gordon endeavored to show some of the difficulties that a composer had to meet, and some of the possibilities. He illustrated every point carefully by playing standard compositions, or some of his own, on the piano.

That is one reason why these talks have meant so much; they are not dry-as-dust lectures, but real, vibrant ideas translated into both words and music.

The two explanations of musical composition made an instant hit. They were followed by several explanations of "The Instruments of the Orchestra," a natural outgrowth of the first talks.

Letters continued to flow to Mr. Gordon, so he decided to speak about the various composers who wrote for orchestra. He gave a series of talks on Beethoven, with copious illustrations from his works. Listeners said that they were charmed, and that they had never realized that classical music could be so beautiful.

The Beethoven series finished, Mr. Gordon proceeded to Wagner. That meant the next step, into opera. And so the radio audience heard him explain the more popular of Wagner's operas. At present, this series is still under way.

Now what does this mean? Here is a young and busy musician who yet takes time to talk to the radio audience once a week about the most important and significant musicians and their works, and does so not because of any vanity or pride, but because the radio audience has shown that they want his work.

"Half my letters come from small towns," he says, "and the others from big cities like New York and Newark and Philadelphia. That shows, I think, that the small town is proportionately more interested in the classics than the city. Radio has a great

When you said tonight that you were going to talk about the composer whom you consider greatest, I hoped you would name Beethoven; and when you did my heart leaped with joy, for I feel that he rises like a lone mountain peak above them all.

Your choice of the second movement of the seventh symphony was happy. This great movement produces always a profound effect upon me and, as usual, my tears flowed freely as your fingers reproduced its magic notes.

Ever new and ever fresh to me, Beethoven's music has made my life richer and better for nearly half a century. EDWARD BLAKENEY, Troy, N. Y.

Have listened to your most interesting lectures (over my radio) on "Musicians and Their Works," and intended writing to you before this, to thank you, and to tell you how much I enjoy them. Some years ago, while residing in Brooklyn, I had the privilege of hearing Walter Damrosch lecture on "Modern Musicians and Their Compositions," in a course of lectures and concerts given under the auspices of the Brooklyn Institute of Arts and Science. Music is the greatest part of my life, and oh, how I have revelled in it since the radio came into my life. I am a daily listener, and every day I realize more and more what a wonder it is—a very miracle. So full of endless possibilities for service to our fellow men if we only have the desire to give out our very selves. We have much to be thankful for, when so much is fully given—sent into our very powers. MRS. AGNES H. LITCHFIELD, Columbus, O.

opportunity to give these people an understanding of fine music, which they can make their own and carry with them for the rest of their lives. If I, in my small way, can help some of my listeners to such an understanding, I am only too glad to do it."

Mr. Gordon is a modest young man of considerable talent, as those know who hear him. His composition "June," which he has played over the radio, he thinks not good enough to warrant publishing, yet he has had innumerable requests for it.

It is with special pleasure that we have listened to your radio talks. Adelaide's greatest regret in graduating from South Side was giving up the Music Appreciation. She said last week that she missed your playing more than anything else, and they have no wireless outfit in Montclair Normal, so that they cannot listen in.

It is a great satisfaction to us to learn of some of the work, and I am taking this opportunity to thank you for what you did for her and for the great pleasure you are giving us. MRS. VAN N. POLHEMUS, East Orange, N. J.

I was listening on the radio, and I had the chance to hear you speak. I come from Panama, Central America, and I had taken piano lessons for quite a while. My teacher, Mr. Daniels, told me about Beethoven and Bach and many other composers. He told me that Beethoven when young (although not very young) became deaf and he said that he played all the symphonies. When I heard you play, I thought you played wonderful.

I will write and tell my piano teacher that I heard the seventh symphony by Beethoven played. From a girl 12 years old. FRANCES MARTIN, Newark, N. J.

When pressed as to the enjoyment he gets out of broadcasting he will confess that "there is a certain pleasure, I suppose, in developing the subject as I go along." He speaks extemporaneously, without notes, having prepared the talk beforehand by study. "There is nobody in the studio with me except the announcer," he reports, "and so it's just like talking to myself." But the real reason why he broadcasts is the fact that the audience has definitely shown him that he is giving them a better understanding of the great classics of music.

UPSTAIRS

They gather about the loud speaker to enjoy the music broadcast from stations far and near

The Radio Equipped Apartment

NEWARK, N. J., has been claiming the distinction of having the first radio-equipped apartment house; whether the claim is justified or not, certainly the Western Electric Co. ought to know when it says that this is the first time its public address system has been so used. A radio receiving set is operated in the pent house on the roof, and connected to the address system, which has outlets in every apartment.

The building thus fitted is the Ritz Apartments, 299 Clinton avenue, and in any of the 72 suites the radio programs can be enjoyed by simply slipping in a plug to connect a headset or loud speaker.

F. B. Kopff, the superintendent of the building, says the popularity of this innovation in apartment house service is evidenced by the fact that but comparatively little elevator service is required in the evenings; the greater number of the Ritz tenants prefer to stay home and listen-in.

The operator in the radio room on the Ritz roof must needs combine diplomacy with ability when he selects and picks up from the air a program that will suit the preferences of all the people in the seventy-two apartments. But thus far he has been so successful in his selection that even a loud speaker could not make the complaints audible, for there have been none. However, should such a contingency ever occur, it will be readily taken care of by installing an additional radio receiving set, permitting simultaneous reception of two programs.

The equipment now used consists of a radio receiving set and a high-power amplifier. There are four vacuum tubes in the receiver, affording two stages of radio frequency, detector and a single stage of audio frequency amplification. The complete set can be operated on dry batteries.

Because of the set's sensitiveness and selectivity every city in the Union which has a 500-watt broadcasting station has been heard by the families living in the Ritz apartments.

By means of a specially designed input coil, the radio receiver is connected to a Western Electric amplifier, in which power tubes provide three stages of audio frequency amplification, the last stage being push and pull.

Radio signals from the receiver are amplified and thence wired to all apartments, each of which is equipped with a headset of high impedance type and with a special receptacle, so arranged that no matter whether a few or all seventy-two headsets be used, the quality and volume will be in no wise impaired.

The possibility that apartment houses which provide radio service may become as tumultuous as the Tower of Babel thus is easily averted. By using headsets there can be no bedlam, and each lessee is given clear reception of broadcast numbers.

Superintendent Kopff believes in the practical application of the old adage: "All work and no play makes Jack a dull boy." He finds that the workers in the big boiler room of the Ritz perform their tasks with much more zest after intermissions or "recesses for radio." Accordingly, at intervals the workers in the cellar are given the opportunity to listen to what the chap on the roof picks up from the ether. And usually the effect is enlivening.

DOWNSTAIRS

They interrupt their labors to dance and step to that jazzy saxophone melody coming over the air

Charles Proteus Steinmetz

Electrical Wizard

THE scientific world was shocked on October 26 by the announcement of the death of the electrical genius who has contributed so generously to the development of electrical science. Returning to his home in Schenectady after a trip to the Pacific Coast which over-taxed his strength, the scientist was forced to a sick-bed from which it was hoped he would be able to make an early recovery and return to labors which he loved. But the weak heart which he had never permitted to handicap his splendid mental powers suddenly stopped its beat.

The career of Charles Steinmetz is an inspiration to every earnest worker, and presents one of the beautiful romances of the technical world. He was born in Breslau, Germany, on April 9, 1865, and received a good education in the universities of Breslau and Berlin. Astronomy was his early choice of study but he later turned to chemistry and electrical engineering. At an early age mathematics presented much difficulty to this boy who was later to be known as one of the scientific giants and accomplished mathematicians of the world. In later years the story is told of him that upon an occasion when he was called upon to solve a problem involving complicated computation and found no table of logarithms at hand, he made his own logarithm table—no small feat.

He developed early a predilection for advanced political thought and so found himself rapidly becoming *persona non grata* with the government authorities. He was compelled to forego his university degree and take refuge in Austria and later in Switzerland, where he continued his studies in the Polytechnicium of Zurich. Here he became acquainted with a young American student who persuaded Steinmetz to come to America.

Steinmetz arrived in this country in 1889, at quite the right period to enter into a profession which was then making a promising beginning. He was 24 years of age, handicapped by an inadequate knowledge of the English language and also by illness, which resulted in his detention at Ellis Island until his American student friend was able to procure his release.

His first position was in the drafting room of Rudolph Eickemeyer, an inventor and pioneer in the production of electrical apparatus. Here, at Yonkers, he was employed at a salary of $2.00 a day. But he rapidly attracted notice by his work on electric motors and generators and his articles contributed to scientific papers. He was a clear, logical thinker and possessed the knack of setting forth his thought in lucid, forceful writing, which later in life was to stand the acid test of such involved subjects as Einstein's Theory of Relativity.

Dr. Steinmetz later was taken into the employ of the General Electric Company where he organized a Consulting Engineering Department. He developed a laboratory at Schenectady worthy of his genius, in which he and his assistants could have all possible facilities in the prosecution of the investigations which he carried on with tireless enthusiasm.

He has latterly been a leader in the effort to obtain and control super-voltage. His experiments in this field culminated last year in the demonstration of a startlingly realistic, miniature thunderstorm with all the natural manifestations faithfully reproduced, in which the wizard played with lightning bolts of more than 1,000,000 volts.

The electrical genius who has for long been our acknowledged leader in scientific America is remarkable not only for the wonderful work which makes him unique; but also for his broad and intensely human devotion to the interests of mankind. Far from holding himself aloof from human interests because of the demands which science made upon his time and energy, he was always an interested observer of the trend of social and political institutions, and he held several useful public offices. The profession of electrical engineering loses a leader in the death, at the age of 58, of Dr. Steinmetz, and the country loses a priceless citizen.

Educational Facilities Extended by Radio

Columbia About to Try Radio in Extending Its Correspondence School

By Edwin Hall

ANY universal thought-carrying medium like radio quite naturally offers plenty of opportunity for speculation regarding its educational features. Education, reduced to its fundamentals, is nothing but a matter of communication. A professor teaches mathematics by communication with his students.

We shall soon be giving knowledge the wings of Mercury. The reason for this belief is founded on fact and experimentation. The writer refers to purely academic education; not what would be received by the masses in the natural course of broadcasting. The experiments in radio education are not numerous, but they have been convincing. The most significant was the one conducted by the New York Board of Education during the month of April, 1923. At that time a class in accounting at the Harron High School was given instructions from the mouth of the loud speaker that was connected by radio to the broadcast station of the Radio Corporation of America. The class assembled in the usual way and the instructor took his place at the microphone several miles distant. Of course, the instruction was entirely verbal and the class could not have been conducted regularly in this way without the use of the all-important blackboard.

A more significant and practical experiment is about to be tried at Columbia University, and to Columbia, far famed for its modern methods of instruction, will come the distinction of being the first institution of learning to try a new method that may eventually make every home a little red schoolhouse or veritable university. For several years Columbia has been distributing home instruction courses for those who have neither time nor money to spend for education. The mails are used in sending out typical correspondence school instruction sheets, and the student's progress is left entirely to his own resources. When there is a keen desire to learn, the correspondence schools are eminently successful, but there are many students who lack the persistency to carry on, due partly to lack of inspiration and sometimes to lack of understanding. Although the courses are prepared as simply as possible, there are always those who fail to comprehend and consequently they fall by the wayside when they reach that portion of their study where their progress is labored.

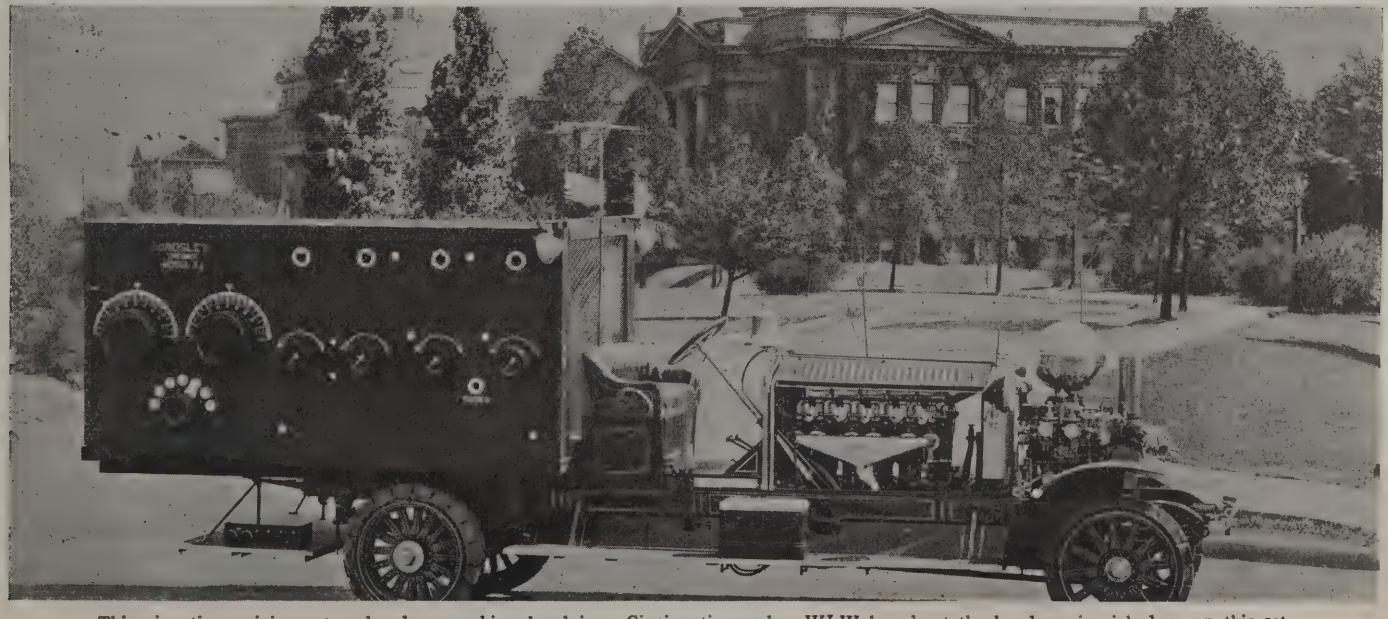
Columbia proposes to supplement its home study courses with lectures by radio and in these lectures the student, if he is within range of the broadcasting station that will be used for this purpose, will be able to have the real live voice of a professor at his side just as though he were attending school. If he is taking a course in journalism, he can hear weekly or semi-weekly the voice of his instructor giving directions regarding the lesson or general instruction on vital points. Even the teaching of such a difficult subject as mathematics could be greatly accelerated by treatment of this kind, and its value to a struggling student could not be over-estimated. Every course of instruction, regardless of its nature, would become easier with the aid that radio could offer.

Columbia's experiment may lead to developments that may make the ether one vast university. The effort will be watched and studied by educators the world over.

Considering the possible importance of radio to our educational system, it would seem to be high time that our educators called a national conference for the purpose of establishing radio's place in education. That it will develop into a powerful educational force is positive. As to the course it will take we are still uncertain, but the implements are in our hands and it would seem that we have nothing to do but learn how to apply them.

In further consideration of this, let us take up the matter of naturalization. We have hundreds of thousands of people in the United States who neither hold naturalization papers nor speak the English language. It is true that the more ambitious of these foreigners go to the evening lectures at the local schools, but at best this is only a small percentage of those who would be benefited by such instruction. A foreign laborer who puts in a hard ten-hour day is not usually in the mood to leave his comfortable chair and home during the evening. The young fellows may, but it takes real effort on the part of the middle-aged man.

It would be a comparatively simple matter to teach such an individual the rudiments of naturalization as well as



This gigantic receiving set replaced a marching band in a Cincinnati parade. WLW broadcast the band music picked up on this set

the fundamentals of the English language by radio. It would seem that our Federal, state or municipal governments should be perfectly willing to co-operate in a matter that is of such vital importance to the welfare of the community and the nation at large. It would be entirely feasible for municipal governments to loan out receivers for this purpose or sell them at cost to those who wished to use them. The responsibility would not be great, since a crystal receiver could be used in the average case. Probably in a city of 200,000 there might be 2,000 foreigners who could not speak English fluently, or perhaps not at all. Let us say that a broadcast receiver was available to fifty per cent. of this number. If a municipality took it upon itself to supply the remainder with crystal sets on loan it need represent only an investment of approximately five thousand dollars. Such an equipment would be a permanent fixture in the city's welfare equipment. It could be used over and over again and in the course of a few years it could be made to be responsible for any service that would triple or even quadruple the number of applicants for naturalization papers. It would allow our communities to assimilate their foreign element with unheard-of rapidity and facility.

There are so many things that radio can do to be of immediate assistance in educational work that one does not know where to begin in outlining them. It does not require much imagination to see where radio broadcasting could render a great and lasting service to our colleges and universities. The lecture is the basis of modern instruction in the higher schools of learning, and the lectures do not all come from the professors of the particular college in which the course is being given.

Every professor is anxious to call in experts to lecture on special subjects that will be of benefit to his students. For instance, in a course in electrical engineering, a wide-awake professor would be more than glad to invite numerous experts and specialists to replace him on his lecture platform during certain parts of the course. For instance, when the subject of thermo-electricity is reached, any professor would be more than glad to have his students listen to a lecture on this subject by such an eminent authority as E. C. Coblentz, of the Bureau of Standards. Mr. Coblentz has made a life study of this small but important branch of electrical phenomenon, consequently he knows a great deal more about it than the average professor.

Let us take a class of students struggling with the mathematics of alternating current. What a treat it would be for them to listen to Steinmetz, whose text books they are probably using. How nice it would be if a class in mining engineering could listen to John Hays Hammond, Sr., or a class in architecture to Cass Gilbert? Yet it is evident that these authorities who have succeded in combining the theory with the practical in the workaday world cannot stop their work and ride 500 miles to give a class of youngsters a lecture, no matter how much good it may do them. With an intelligently planned inter-collegiate or inter-university broadcasting system, there is no reason in the world why such men could not reach the hungry ears of hundreds of thousands of students.

If all of our educational forces were to co-operate in establishing such a system, untold benefit would result. Our professors could exchange classes with ease and the student body could listen to others outside of their own faculty. It would make the bonds between our institutions of learning tighter and co-relate our entire educational system at the same time tying it up with the workaday world—thereby supplying an influence that has been sadly lacking.

Prize Contest Announcement

WIRELESS AGE announces a prize contest for the best 100-word letter, telling—

WHY I BECAME A RADIO FAN

Closing Date, December 31, 1923

Contestants are requested to submit articles at the earliest date practicable.

Prize-winning letters will appear in the February, 1924, issue.

Address all letters to the Contest Editor of THE WIRELESS AGE.

First Prize $10.00

Second Prize 5.00

Third Prize.... } One year subscription to WIRELESS AGE

Fourth Prize... }

Fifth Prize.... }

Prize contest conditions—Letters on the subject announced above will be judged by the Editors of the WIRELESS AGE with particular regard to the story value and interest in the circumstances described. Ability to tell the story well will also be considered, of course. The contest is open to everybody. Closing date is given above in the announcement. In addition to the prizes mentioned, regular space rates will be paid for the space given to the winning letters, in the February, 1924, issue.

English Listeners Like Programs and Modulation of WGY

REPORTS of the reception in Europe of American broadcasting stations are already being received here following the return of cool weather and longer nights. Twenty-one English radio fans have written WGY, the General Electric Company broadcasting station reporting successful reception of the Schenectady station's program during the first week in September. The reception of WGY gave the English listeners the interesting opportunity of comparing the programs and quality of modulation of two continents.

W. E. Philpott of Rye Sussex, England, picked up WGY in the early morning of September 1. He writes, "Congratulations on the fine modulation. You were quite equal to Birmingham and Manchester."

Henry Myers of Low Fell, Durham, England, heard WGY and writes, "For consistent strength and clarity the concert came through much better than I get the London transmission."

J. Rhodes writing from Leeds, Yorkshire, England, said WGY was as "clear as Manchester 40 miles away."

The report of H. L. Holt of Manchester, England, is especially interesting inasmuch as he receeived WGY on an indoor aerial. He writes: "The apparatus I was using consists of an indoor aerial across the kiddies' bedroom and the ordinary detector and one stage of low frequency. The aerial is just a length of bell wire stretched backwards and forwards across the room in the form of a W and a V and then through the floor to the living room below the set. The tuner is just an ordinary single circuit regenerative one." Reception on a loud speaker strong enough to wake a person sleeping upstairs with bedroom door shut, is reported by T. Hall Felton of Grimsby, England. Mr. Felton was listening in with his father, Dr. E. H. Felton, who is vice-president of the Grimsby District Radio Society. He has a five-tube experimental set.

Better Order Your December Wireless Age *Now!*

Here are some of the feature stories by well-known authors, that will appear in this issue:

RADIO MAKING SPORT INTEREST NATION-WIDE

By Raymond Francis Yates

Do you realize the increased interest in sports which the most sport-loving nation in the world is displaying since it has become possible to bring the great sport contests home to the millions? We of America feel a justifiable pride in our sporting supremacy which undoubtedly underlies some of our success in the more serious activities and it is inspiring to realize that radio broadcasting which is developing so much more rapidly with us than abroad, is going to make our wives and our daughters, our neighbors and our remotest countrymen—sport fans, sportsmen and sportswomen.

Picking Up Broadcast Music.

Alfred N. Goldsmith, B.S., Ph.D., Fellow, I.R.E. tells how the musical tones of vocal or instrumental artists have to be introduced into the microphone, amplified with scrupulous care and transmitted, in order that they may carry to the listener's ear without distortion.

Little Journeys Into Radio Computations.

Carl Dreher, who contributes this very readable article, is a member of the Institute of Radio Engineers and an associate of the American Institute of Electrical Engineers. "I was led to write this article," he says, "by a physician who has a working knowledge of algebra and who became interested recently in radio. He wanted a discussion of some of the fundamental relations in mathematical form, because the usual water analogies and other popular methods of treatment did not convey the subject in a complete enough manner."

Applying Radio Frequency to Standard Circuits.

In this article, Mr. Ward will give the facts about Radio Frequency Amplification and its application to all proved circuits now in use. Whether you are using a single or double circuit, Reinartz or Cockaday tuner, this article contains the "dope" you want.

A Low Distortion Audio Amplifier.

Distance has been conquered. Now everybody is interested in obtaining in broadcast reproduction a degree of quality that is comparable to the very presence of the artist, in the loud speaker. Mr. Ringel will describe in detail an audio frequency amplifying circuit in which distortion has been almost entirely eliminated.

What To Do Until the Doctor Comes.

All those who have had their set cease operating right in the middle of an interesting entertainment raise their right hands! If you haven't bothered much about the technical side of radio, and want to know how to correct minor troubles in your set without learning all about the complicated do-funnies, Mr. Duncan's article will be just the thing for you.

Back of Broadcasting.

Have you ever stopped to consider the men, machinery and wires behind the programs that delight you every day in the week. To those who are interested in the equipment which makes it possible to transport churches and theatres to their living rooms, Mr. Ranger's article will prove mighty interesting.

How Broadcasting Helps the Country Store

By O. M. Kile

A. C. HOEFNER runs a general store of New Melle, Missouri, He handles the usual general store merchandise and buys poultry and eggs from his farmer customers. This is how radio aids him; as told by himself:

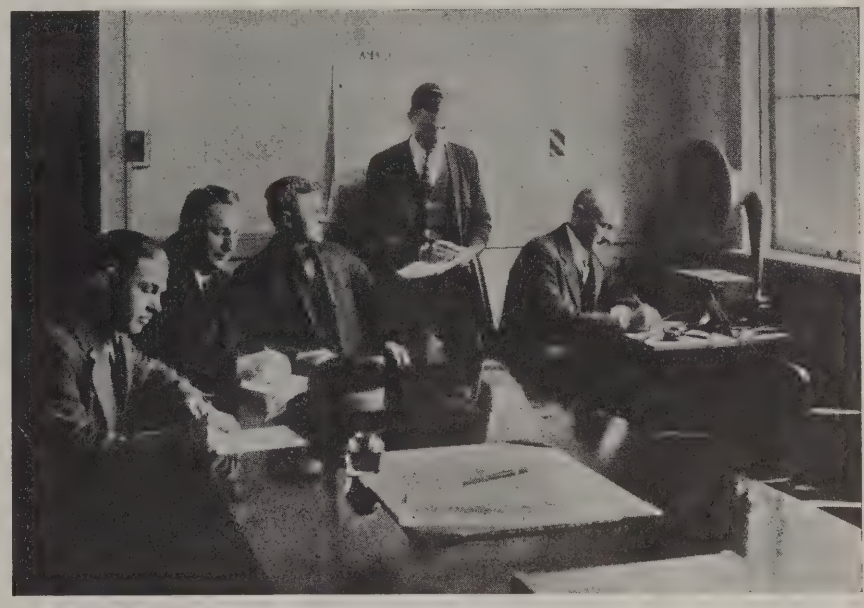
"We are located in an inland town eight miles from a railroad, and only have mail service once a day. We used to be exactly 25 hours behind the market, since our market is set by the prices at St. Louis at 11:30 a. m., and printed in the evening papers which do not reach us until 1 p. m. the next day. Now we get the report by radio at 12:40, or one hour and twenty minutes after the market is set for the next twenty-four hours.

"With this service there is no chance for a repetition of what happened to us in the spring of 1921. One day that spring eggs dropped six cents a dozen. One of our customers who gets his mail by rural route from another point on the railroad, read this in his paper at 9 a. m. Knowing that our mail would not get in until 1 p. m. he rushed us 60 dozen eggs, thereby causing us a loss of $3.60 on a single customer.

"On the other hand we want to pay what produce is worth and now are often able to give our customers two or three cents a dozen more for eggs than they expect. We raise and lower our prices according to the radio quotations now.

"We have a flour mill here in town, also, and the manager always gets his market figures from me. He then buys his wheat, corn, and oats according to these reports."

C. A. Morton, of Morton & Co., a large St. Louis commission firm, who is in touch with merchants throughout that territory, summarizes the benefits of broadcasted market reports as follows:



Tillers of the soil getting market quotations by radio

"First, the margin of profit in the grain trade is based on the risk involved, and when the miller or grain dealer is in close touch with the markets and doesn't have to take the overnight risk, he will and actually does buy from the farmer on a narrower margin.

"Second, the farmer is as well posted as the miller or grain dealer, and he can insist on getting actual value for his products, whereas under the telephone or telegraph system, he was 24 hours or more behind the markets.

"There is another angle, not directly connected with the grain trade, that has come under our observation, but which is a parallel illustration of this latter point. Several times we have been in a grocery store or meat market and have heard some housewife 'call' the dealer because of the prices asked for eggs and poultry, quoting the market prices as broadcast by the St. Louis *Post-Dispatch,* station KSD. Business runs more amicably, and at least profitably enough, when everyone concerned knows the actual conditions."

In the Shack Abaft the Funnel

By Ortherus Gordon

"Under the spreading wires aloft,
The sea-going outfit stands,
Receivin' and sendin' on and off,
And agoin' to foreign lands."

DEAR LOFTY:

Now that you can copy eight words a minute and have already applied for a second grade amateur license, I suppose you are aching to run away to sea and pound a wicked nautical key. Don't do it! Stay at home where you can broadcast your call letters over the community without knocking your head on seagoing rafters, or ruining your innards with uncooked seaweed and raw tripe. Furthermore, as my last skipper was fond of quoting: "Don't hoist your mainsail 'til your blocks are greased!" and whatever advice you can dig out of that you are welcome to. What he meant was, don't even look at salt water until your glasses are smoked, your sea-legs bought and paid for, and you are sure everything is going to hold taut.

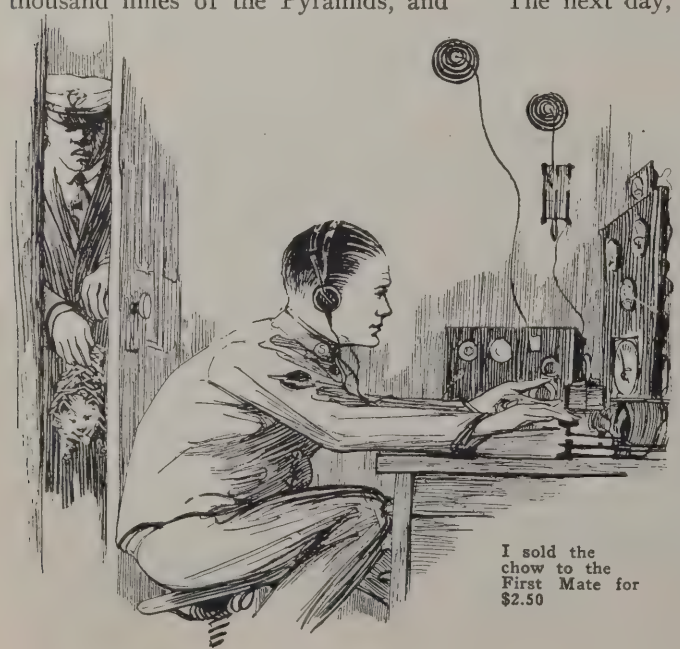
Take a sidewise glint at me, for example. I'm so salty now that I'll keep perfect for years after my death—but I wasn't always thus coated with brine. There was a time when I walked straight and wore my hats like other humans. You were in the crowd that morning I left home for Egypt and the Pyramids—at least that is where I thought I was going, in my innocence and bliss—with twenty words a minute stowed away under my skull. Well, to make a short story shorter, you know how quickly and cruelly I was disillusioned, how I never got within three thousand miles of the Pyramids, and how I was finally shunted off on a cattle boat to Europe. My self-respect dwindled from that day to this—and my ability correspondingly increased. I stuck to it, however, where many another would have gone home, with the result that now I occupy a room, a clothes-closet and a washstand all by myself, while two juniors live in half the cubic space right alongside of me. They hear the whirr of my electric fan and wish the bulkhead were as porous as it is thin.

Life at sea, Lofty old gin-pole, is not more than half bad. One gets around to see things and that means a whole lot, and after all the discomforts are paraded out and rehearsed the ultimate conclusion is that it is a lot of fun.

Take this last cruise, for example. You know all about my overland travels and troubles up to and including my triumphant entry into Seattle, and my joyous reception at the offices of the Hinge Steamship Company, the same with the motto "We are the Gate to the Orient" on its letterheads. I was assigned as Chief Operator on the ocean craft *Startinstop,* and after I had pinned my license on the pale green wall of the shack abaft the funnel, I reported to the Captain that the ship, as far as the dot and dash end of it was concerned, was ready to set out on her maiden voyage.

As a first attempt, the ensuing voyage was a fizzle. There wasn't a thing maidenly about anything that the *Startinstop* did, but we finally seeped into Shanghai.

The next day, the third operator—who had been there before — took me over to the local wireless huts and smoothed my entry into the radio circles of Shanghai. The two stations there are French and Chinese in nationality, but identical in their absurdity; the first with call letters that sound like seltzer water. FFZ, and the other with the back - handed call of XSG. Blows have been struck in the numberless arguments that have arisen over the equipment of these stations. Each asserts possession of the original set from the Ark, but from personal observation, I am sure that such instruments as they own were not only obsolete in Noah's time, but also forgotten. What these fellows have is really the old celestial outfit from the Garden of Eden, the same with which Adam and Eve listened in on heavenly concerts. Even with this remote look about them, the sets compare not unfavorably with some that were placed on the Shipping Board vessels during the war.



I sold the chow to the First Mate for $2.50

The receivers are panels five feet long and three feet high built into the wall of the building and anchored to the foundations thereof—and have an aspect that could not be softened by an earthquake. It is common belief that these sets can tune as close as thirty meters. That is erroneous, and I am glad to be able to qualify that belief by personal knowledge of the true facts. I myself listened in at FFZ one evening, and with the smallest change of inductance I tuned out a station on six hundred meters and brought in another on five thousand!

The transmitters are of no particular type—just mechanical monstrosities embracing all the known types of sending gear and a few of the unknown. To send, it is necessary to stand up and work a key as if you were drawing water from a well. The operators are to be congratulated on their ability to send out intelligible signals with such a key. When I hear them working now, I think of the poor cuss at the pump handle and refrain from employing profane language.

The very first commercial outfit I ever laid eyes on was far better than either collection of curiosities at Shanghai, and that is saying a good deal, for the shack and instruments aboard that cattle ship were half a shade this side of the limit.

I've often asked myself how I managed to get in the shack in which I handled my first ship messages. I must have closed the door as I sidled in for when I was composed enough to look around, I found myself with my back to it and facing the operating table at short range. Nothing about the room was spacious, the actual dimensions being six by six by just enough to crack me on the head when I stood up. On this ship, luckily, I had another room to go to when I wanted to straighten out my ears and rest my weary and battle-scarred head. The receiver—for that is what I finally decided it to be—was turned corner-

wise on the table with the headphones on a hook underneath. With all the courage I could command I pressed my fingers on the buzzer test button. I was thrilled through and through! It actually worked! That surprised me later, for it was the only thing that did—and even it went bad on a few needy occasions. The operating key I dared not press. I was afraid it would fall apart. It had as much side motion as it had up and down and the knob came off at the slightest provocation. The first contact I made with it a few days later made a noise like sputtering bacon and I promptly shut down for two hours. My change-over switch was a marvel in its line. To this day I have yet to see the switch that can break down as many circuits with a single throw and build up as many more with the same throw as that one. I touched it and moved it a trifle—and it fell into eight small pieces on the deck.

Crowding in on my right elbow as I leaned over the table was the operating panel. I despaired of ever finding out what all the meters, switches, fuses, circuit breakers and starter coils were for, but with the aid of a blueprint dug out from the underpart of a young stationary store in the drawers down the side of the table, I followed them all through from their start to their finish. There was a heavy coating of verdigris all over the instruments, and as it later developed, as many short circuits as long. Near the panel was the transmitting gear, rickety, decrepit and old-fashioned, with a mushy quenched spark gap as its most on the table. Everything I had been taught to look for in a sending set responded to a hasty roll call, from the imbecile jigger coil to the preposterous condenser, with its handle for changing the wave length sticking out unsupported into midair. We worked in three channels those days—450, 600 and 952. The only instrument that was neat and silent was the motor generator, and that was buried away in the engine room with a push button control on my table. All this, I thought, as I took in the whole dilapidated outfit with a single glance, is something that resembles nothing, but it is my wireless station. (You should have seen it—and heard it—a week later. That's how I earned my rep; such as it is!)

Underneath the table I discovered a sort of seat, which I immediately hauled out to sit on, but I had barely sat down when the door opened suddenly and nearly knocked me unconscious with a smart crack on the back of my head.

"If you are the new Sparks," bellowed a voice, "drag your carcass below and sign the articles."

That's all I was able to do—drag; and staggering under the weight of it, I went in the general direction of below and came upon a room full of ex-bartenders and sailors. The ex-bartenders were folding and ruffling imposing sets of papers and covering them with blotters while the sailors signed them. These were the ship's articles. I had never signed them before, and didn't know just what they were all about. Lately, being a little better informed, I know that when I sign on the dotted line, I agree not to eat more than my allotted ration of hard tack and rice, and to subsist on three United States Army Emergency Biscuits in case of shipwreck. But to get back to this trip in the *Startin-stop*—I decided in Shanghai to get a Chow dog and take him home with me. He was just a tiny thing, and he sure was cute. But, oh what a pest! Bad as he was though, the only person to really complain about him was the Second Mate, who was a dizzy goof in my opinion, so I didn't waste any time following out his sarcastic instructions or worrying about his threats. At the same time I was forced to follow the "Chow" critter around pretty closely to prevent what might easily assume the proportions of a personal insult to the dignified Second Mate.

The dog was taking too much time away from my slumber, and seeing a chance for a scoop in the way of general revenge, I sold him to the Third Mate for two dollars and a half, cleaning up four bits on the deal. As I expected, the Second Mate raised considerable smoke and the Third Mate retaliated in a fashion that almost brought the two to blows. To prevent further estrangement, the dog was given to the steward—who allowed the passengers to make a plaything of him. One dark night, he was left out on deck, and in the morning, the horrible story reached me that he had been washed overboard by the deck swabbing contingent of the Bosun's Mate.

Keep away from the sea, Lofty—you'll like it better. As for myself, I'm coming home and write a technical treatise on how impossible it is to transmit messages with an aerial that is so leaky that every time the Captain puts his mouth to a voice tube to telephone to the engine room he singes his whiskers and gets an electrical chin massage that stays with him from then on. There are a lot of funny things happen in the shack behind the funnel, and not among them are the words the Skipper uses when he comes back to the cabin after receiving such a startling reminder that there is such a thing as radio aboard the ship.

Yours for home and a solid ground,

VIC.

Church Bell Broadcasts Time Signals to Farmers

MANY stages of amplification and three different wave lengths are used to get Arlington time signals to the farmers in the vicinity of Medusa, Albany County, N. Y.

C. J. Waldron, a Medusa resident, lives next door to the church. He has added a few feet to the length of the bell rope and every noon, after tuning in WGY, the General Electric Company station at Schenectady, N. Y., he sits in his rocking chair with phones on head and bell rope in hand, waiting for the long Arlington note which marks twelve o'clock. At the long note he pulls the bell rope, and the bell, which is a big one, broadcasts the time signal miles around.

The signal passes through three different wavelengths — from Arlington on 2,500 meters, through WGY on 380 meters and the bell tone which has not been measured.

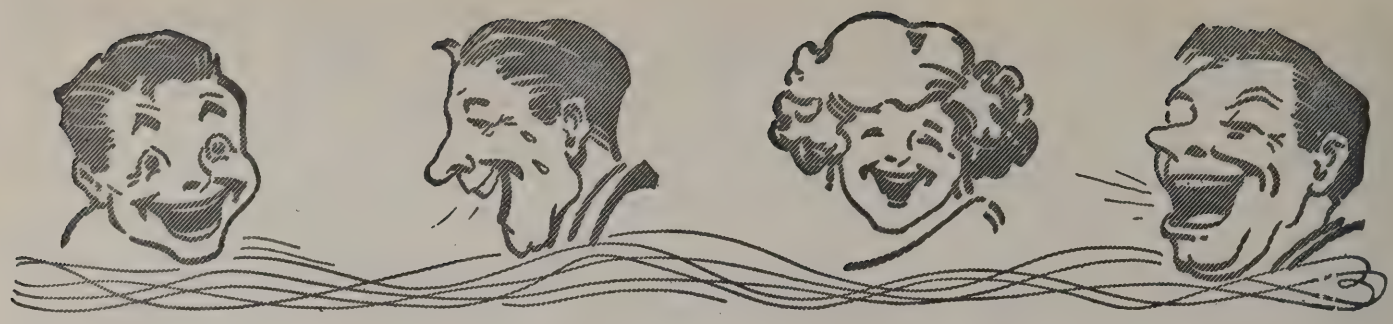
Time Signals Tell Where You Are

(*Continued from page* 31)

especially strong the response to the time signals, strong enough to operate a telegraph relay, which in turn governs the movement of the recording pen.

The recording unit does not differ essentially from that of other mechanical means for copying wireless messages in the absence of human ears. A sheet of paper is wound around a cylinder. The latter is rotated at a uniform speed by a clockwork, actuated somewhat like the grandfather clock, by falling weights. When off duty, the recording fountain pen traces a straight line, which for the sake of identification, is called the datum line. When receiving radio signals this pen leaves the datum line in accordance with the dots and dashes. This permanent record is readily deciphered by anyone who possesses a copy of the code chart. The services of a radio operator are dispensed with.

Other than serving the specific needs for which it was invented, namely, automatically recording radio time signals for making determinations in the differences of longitude, this apparatus is able to copy long-distance radiotelegraph communications from distant points. It is said to be the first automatic radio recorder that employs only one electron tube and yet is capable of receiving and recording radio-telegraph signals from Europe. It is portable, lending itself to carriage on an automobile, and can thus be employed by the Coast and Geodetic Survey in surveying expeditions to unfrequented and remote corners of the United States and its possessions.



Laughter on the Radio Wave

The Ship Operator

By Frank Chapman

Say, d'you know it's a deuce of a task
To answer the questions that passengers ask?
For a land lubber's questions out on the sea
Run through all the letters from A down to Z.

"Do you sail at night time?" they ask with a smile.
"And say, when it rains, do you stop for a while?
For you know, when it's raining (that is, I should think)
It would run into the cellar and make the ship sink.
And that bell there a-ringing; do you know, it struck eight?
My Lord, how the time flies, who'd think it so late?"

And then you explain, as you've done o'er and o'er,
About the bell ringing, the time being four.
"Do you ever get seasick?" And you answer with glee,
"I never get seasick, but sick of the sea."
"How far do you think we are off from the shore?
Is it just a few miles, or is it some more?"
And you stand there and wonder how much they will stand.
Then risk it at five thousand miles off the land.

And should ever a lightship come into view
You've got to get busy and answer a few.
"Is that boat anchored there or tied to a rock?
And why is it there and not at the dock?
And are there men on it there day after day?
How do they stand it, and what is their pay?

"Do the flying fish sing as they fly through the air?
And do they have feathers like gulls flying there?
Do you ever get homesick?" Now here's where they sigh
With sympathy showing in each anxious eye.
And you say in a voice that the sea has made rough
"Why, no, for you see, I'm not home long enough."

Then they ask if you're married—you know how it is.
If the passenger's fair and you're on to your "biz."
Just what would you tell her, and she all alone
And three or four hundred miles from your home?
Say, d'you know it's a deuce of a task
To answer the questions the passengers ask.

—*Baltimore Sun.*

NOWADAYS

By Percy Crosby

—*Brooklyn Eagle*

Observation

It used to be that a phonograph cabinet was merely a phonograph cabinet and nothing more. Nowadays it's hard to tell whether it's a phonograph cabinet, a radio, or a pipeless heater.—T. A. Sangan, Jr., in *N. Y. Globe.*

A Radio Romance

Lily's vacuum tubes were burning,
While my heart was wildly yearning
For a kiss!
Lil forgot me quite completely
As she tuned her set so neatly—
Frigid Miss!

Lily's hair, intoxicating,
Tantalizing, aggravating,
Brushed my cheek.
How I longed to kiss these tresses—
With my own lips' fond caresses
Hers to seek!

"No!" her answer was emphatic
As the crashing of the static—
What a din!
As I murmured: "Dear, take pity,"
Lily shouted: "Kansas City—
Tuned 'em in!"

As the signals came in clearer,
Lily's head kept coming nearer—
Glossy head of black—
Then she said: "Such oscillation
Justifies some osculation"—
Smack! Smack! Smack!

—Arthur L. Lippmann, in the N. Y. *Eve. Mail.*

Georgie: "When I got up this morning I found the detector tube all wet. What do you suppose caused that?"

Porgie: "Probably the grid leak."

Bow, wow, wow!
Little Super Tuner's set,
Whose set art thou?
Bow, wow, wow.

"Father is Scotch and takes the headphones off when the minister announces the offering," wrote eight year old Harold Midgley of Galt, Ontario, Canada, to one broadcasting station.

Mothers' Helper

Hint to distracted households, from a letter to a bed-timer: "I want to thank you for the pleasure you give my two younger children each evening, when we put on the phones and have *complete silence* for a half hour."

Wireless Wonders

Attendance at our meeting house
Was limited to one starved mouse;
Until the thought struck Deacon Snow
To make us good by radio.

The folks they all turned out for fair
To get religion from the air;
But Deacon must have crossed his wire—
'Cause that dern box up in the choir

Yelled out, "Babe Ruth is now at bat,
Dusted the plate off with his hat.
Strike one—the crowd in great sus-
Busted a homer to the fence."
pense;

A fool kid whooped right out, "Eeyow!"
And Deacon mopped a clammy brow;
But our folks 'tend church as they should,
Since science came to make us good.

—M. H. R., in Louisville *Courier-Journal.*

Wireless Wit in Cartoons

AIN'T IT A GRAND AND GLORIOUS FEELIN'?

By BRIGGS

WHEN YOUR FRIENDS PILE IN ON YOU TO HEAR THE FIGHT RETURNS OVER YOUR RADIO AND AT 8:30 YOU GET STATIC
-AND AT NINE OCLOCK YOU GET WHISTLES AND SQUAWKS
AND AT 9.30 YOU GET YES WE HAVE NO BANANAS
-AND AT 9.45 YOU GET DISGUSTED
-AT 9.48 YOU GET FRANTIC
-AND THEN AT 9.50 THE BIG FIGHT RETURNS BEGIN TO COME IN- OH-H-H-H BOY! AIN'T IT A GR-A-RAND AND GLOR-R-RIOUS FEELIN ?
BRIGGS +M G

—*N. Y. Tribune*

SAPPO

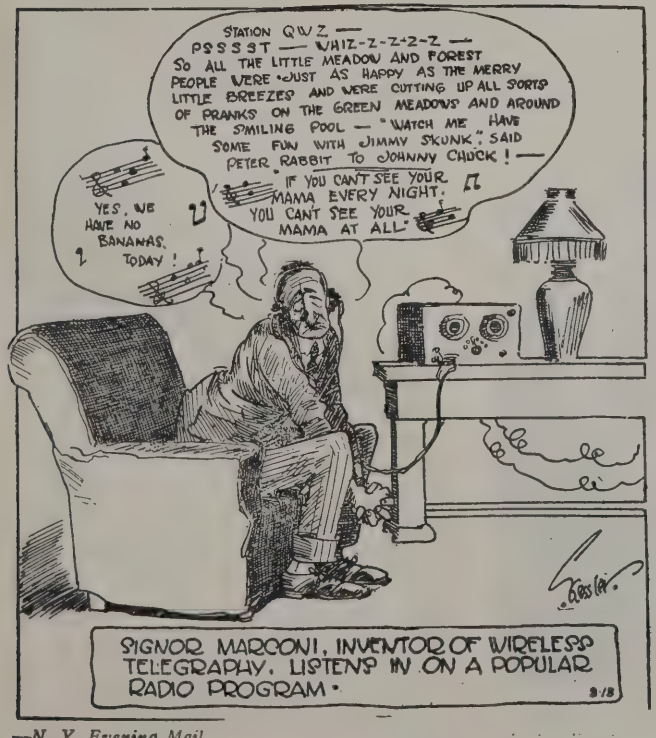
By SEGAR

OH, HELLO, MRS. DINGLE, HOW ARE YOU TO DAY?
JOHN MRS DINGLE IS ON THE PHONE - THERE'S SOMETHING WRONG WITH HER RADIO
SHE WANTS TO TALK TO YOU
THAT WOMAN IS ALWAYS HAVING TROUBLE WITH HER RADIO- SHE DOESN'T KNOW A THING ABOUT IT, GEE, BUT SHE'S DUMB
I DON'T THINK YOUR RADIO WILL WORK ON ACCOUNT OF THE "GRID LEAK"
8-24
SHALL I CALL A PLUMBER?
IF YOU DON'T GET THIS IDEA - STUDY UP ON RADIO —— SEGAR

—*N. Y. American*

DARK MOMENTS IN BRILLIANT LIVES

By KESSLER


STATION QWZ — PSSSST — WHIZ-Z-Z-Z-Z — SO ALL THE LITTLE MEADOW AND FOREST PEOPLE WERE JUST AS HAPPY AS THE MERRY LITTLE BREEZES AND WERE CUTTING UP ALL SORTS OF PRANKS ON THE GREEN MEADOWS AND AROUND THE SMILING POOL — "WATCH ME HAVE SOME FUN WITH JIMMY SKUNK," SAID PETER RABBIT TO JOHNNY CHUCK! — "IF YOU CAN'T SEE YOUR MAMA EVERY NIGHT, YOU CAN'T SEE YOUR MAMA AT ALL"
YES, WE HAVE NO BANANAS, TODAY!
SIGNOR MARCONI, INVENTOR OF WIRELESS TELEGRAPHY, LISTENS IN ON A POPULAR RADIO PROGRAM.
3/8

—*N. Y. Evening Mail*

HOW TO TORTURE YOUR WIFE—By H. T. WEBSTER

FASHION TALK FROM STATION BLAH
NEXT WINTER, THE FURS MOST WANTED FOR DAYTIME WEAR WILL PROBABLY BE HUDSON SEAL, MOLE, GREY SQUIRREL, MINK AND KOLINSKY. SOME OF THE FURRIERS PREDICT A GREAT VOGUE FOR PERSIAN LAMB
— ALTHOUGH THE BOND MARKET CONTINUED SOMEWHAT DULL YESTERDAY QUOTATIONS GENERALLY IMPROVED. ACTIVE TRADING WAS CONFINED TO THE INDUSTRIALS —
TURNS TUNER FROM STATION BLAH TO STATION PUNK
SWITCHES FROM STATION PUNK TO STATION KUKU
SEXTETTE FROM LUCIA
YES, WE HAVE NO BANANAS - WE HAVE NO BANANAS, TO-DAY!
GETS STATION OOOSH
— EVER SINCE I BECAME A STAR ON THE SILVER SCREEN I HAVE TRIED TO GIVE MY PUBLIC SOMETHING BETTER AND FINER —
PICKS UP STATION LOCO
— IN THE YEAR 1920 THE TOTAL DEATHS FROM CANCER AMOUNTED TO —
CATCHES STATION BUNK

—*N. Y. World*

WORLD WIDE WIRELESS

Radio Service Maintained Between U. S. and Japan

IN response to numerous inquiries received from the press and the public who have relatives, friends and business associates in Japan, Gen. J. G. Harbord, president of the Radio Corporation of America, announces that everything humanly possible is being done to maintain direct radio communication between the United States and Japan.

The communication between the Pacific group stations of the Radio Corporation system has been uninterrupted and in direct operation since the first news was received of the earthquake and fire which caused such havoc and destruction in Tokio, Yokohama and surrounding regions.

Dispatches have been received consistently from Japanese high-power radio plants, which consist of a transmitter at Haranomachi, and a receiver at Tomioka, which are respectively 178 and 155 miles north of Tokio. These stations were not damaged in any way and are in constant operation. The only interruption in communication with devastated regions was felt when the land line systems which link Tomioka with Tokio and Yokohama were destroyed. A substitute for these land lines is being attempted in the form of a fast courier system and other means that will expedite the exchange of messages between these two cities.

Realizing the urgency of the situation, the Japanese ambassador at Washington has just dispatched a radiogram to the Japanese superintendent of the Tomioka radio station, suggesting that steps be taken to provide means of communication between Tomioka radio station and the cities of Tokio and Yokohama, adding that the Radio Corporation is willing to meet the expense involved providing immediate connection is made with the Japanese cities mentioned.

A message just received from the corporation's San Francisco office states that the high-power radio station at Marshall, Cal., and Kahuka, Hawaiian Islands, are working direct with Tomioka, and that signals from Japanese stations are very clear and regular.

U. S. Government Radio Committee

THE United States committee of electrical and radio experts representing eight government departments having to do with radio and other electrical communications has been announced by the State Department. This committee, headed by Under-Secretary Phillips of the State Department, will meet at an early date to consider the plans and policies of the government on matters pertaining to international electrical communications.

The agenda prepared by the committee will become the basis for the United States' report to the fourth international conference when it is held in Paris. It is probable that the American delegates to that conference will be selected from the personnel of the committee. The international conference was to have been held this spring but was indefinitely postponed.

The following are the government department representatives:—

State, William Phillips, under secretary, chairman; treasury, Lieut. Zeusler, United States coast guard, and Constructor Walton, alternate; army, Maj.-Gen. George O. Squier, signal corps, and Maj. W. E. Prosser, alternate; post-office, Second-Asst.-Postmaster-General Paul Henderson; navy, Rear-Admiral W. R. Shoemaker and Commander D. C. Bingham, alternate; agriculture, W. A. Wheeler and E. B. Calvert, alternate; commerce, Solicitor S. B. Davis and P. E. D. Nagle, alternate; and United States Shipping Board, L. L. Lee, chief radio division.

Macmillan Greets N. Y. Show

EVEN though the polar ship *Bowdoin,* carrying Prof. Macmillan and his crew of explorers, are many hundreds of miles from New York, the men aboard ship have not lost interest in the development of radio in the United States. Saturday afternoon soon after the exposition was officially opened the following radiogram was received by the management of the show from Macmillan in winter quarters near Greenland. The message was relayed from the *Bowdoin* through the amateur station of Jack Barnesley, a Canadian operator:

"My compliments to the management and to the exhibitors. I want to congratulate all radio manufacturers in the United States for their excellent work in this great industry, which has made possible the elimination of the greatest hardships of the Arctic, namely, solitude. My sincerest compliments to you.

"DONALD B. MACMILLAN."

This is the first time a polar exploring ship has carried equipment by which the crew could be kept in touch with events in their home country.

The National Association of Radio Broadcasters in convention in New York City represented by Raymond Walker, C. H. Anderson, Frank W. Elliott, E. F. McDonald, Paul Klugh, W. S. Hedges, J. E. Jenkins, A. B. Cooper, John Shepard and Powell Crosby

Army Radio Service Pays

THE Army Radio net, valued at approximately $500,000, made a return to the Government of over ten per cent. during the past fiscal year, on paper. From June 30, 1922, to July 1, 1923, the traffic handled by the Signal Corps radio net would have cost the Government $66,375 at government rates via commercial wires. The actual cost of these operations was $13,840, which shows a paper saving of $52,535. Actually official messages are handled without cost, and the few private and commercial messages handled, where other radio service is not available, is charged for at slightly over commercial rates, the money being turned over to the Treasury of the United States.

During the fiscal year ended July, 120,968 official messages were handled by the Army's Message Center in the Munitions Building in Washington.

In the Army's radio net there are today thirteen main stations, 43 corps area stations and 12 air service or flying field stations, making 68 principal stations. In addition there are auxiliary stations which bring the number to 112 radio stations.

New Radio Beacons

A RADIO fog signal has been established by the Bureau of Lighthouses on the Nantucket Light Station, Nantucket Shoals, Mass. The signal characteristic consists of a group of four dashes every 30 seconds, silent 25 seconds, on 300-kilocycle frequency or 1,000-meter wavelength.

An automatic radio beacon has been established by the Canadian Government on the Heath Point Lightship off Heath Point, Gulf of St. Lawrence. The station will transmit on a wavelength of 1,000 meters with a spark frequency of 500. The characteristic of the station will be a series of groups of four dashes transmitted for a period of 60 seconds followed by a silent interval of four minutes. The elapsed time from the beginning of one group of dashes to the beginning of the next group will be four seconds. In foggy weather the automatic transmitter will be in operation on 1,000 meters continuously except when the operator is on watch. Requests for radio signals for direction-finding purposes should be made on 600 meters.

Radio Installed on Boston Fireboats

BOSTON has installed radio telephone and telegraph apparatus on its entire fleet of fireboats. Engines 31, 41 and 47 are now being equipped with the latest type tube telephone transmitters, so they can be in direct communication at all times with the fire headquarters on Bristol street, which is to be similarly equipped. Radio has thus found another means of furnishing a service heretofore unavailable to this class of fire-fighting apparatus.

The potential advantages of such communication can be readily realized at the present time, if an order is to be given to the commanders of the fireboats, it must be telephoned to some point near the changing location of the boat and relayed by messenger to its destination. This causes considerable delay and is a very inefficient means of communication.

Should a fire break out on the waterfront involving a large area, this method of communication would, no doubt, fail. Again, suppose the three fireboats were fighting a fire and another blaze should break out several miles away. This information could be instantly telephoned to the fireboat captains and one of the fleet could be dispatched to the scene of the new blaze. Radio will be an important factor in eliminating loss of time.

Foreign radio sets on exhibition at the N. Y. electrical show. At the left is a British Army short wave tuner, next an Italian Army short wave receiver, then a British power buzzer and amplifier, a combination French Army transmitter and receiver and next a long wave French Army receiver

Radio Helps Burning Ship

THE steel freighter, *Diana Dollar,* in serious difficulties in Banderas Bay, Lower California, 650 miles south of Los Angeles harbor, broadcast the need for "assistance at once," because of a "fire and explosion in number 6 hold."

It was later learned from the *Cacique,* Pacific mail liner, that the latter vessel was going at full speed to Banderas Bay from a point 75 miles distant.

Before the *Cacique* reached the burning freighter, apparently she went back to her course, as she had learned the steamer *Coahuila* and the transport *Argonne,* the former only 50 miles distant, were both rushing to the *Diana Dollar's* aid.

Giant Antenna at Koko Head

A NEW radio antenna system, six and a half miles long, with the object of protecting messages from interference and to maintain them in absolute secrecy, has just been installed by the Radio Corporation of America at Koko Head.

The antennas are strung in a direct mathematical line with the company's station near San Francisco and will receive signals on a wavelength of approximately 12,000 meters.

Radio Tests in Grand Canyon Successful

THE Geological Survey party carrying a radio set on a trip through the Grand Canyon of the Colorado, has arrived safely at Bright Angel trail. Notwithstanding the predictions of experts that it would be impossible to receive radio messages while in the bottom of Grand Canyon, Colonel Birdseye reports that he was in daily receipt of messages broadcast from Los Angeles, Salt Lake and Chicago.

Radio Set Installed in Sing Sing

A RADIO set has been installed in the death house of Sing Sing prison, New York. The idea was suggested by the prison electrician and supported by the Salvation Army. The outfit was presented to the death house by David Sarnoff, general manager of the Radio Corporation of America.

Radio in McCall, Idaho

RESIDENTS of McCall, Idaho, are among the most enthusiastic boosters in America. The town is four days from a railroad and receive mail but once every six weeks. Radio is depended upon almost exclusively for contact with the outside world.

Denver to Have Powerful Broadcasting Station

DENVER, COLORADO, has been selected as the site of the third powerful radio broadcasting station of the group to be operated by the General Electric Company, according to an announcement made recently by Martin P. Rice, director of broadcasting for that company. Work on the new station will be started as soon as the company's new broadcasting station at Oakland, California, is finished, probably in December.

The Denver station will complete the General Electric chain of broadcasting stations so far planned. WGY, at Schenectady, has been in operation for the past 18 months; Oakland, the second station, is the first to be housed in a structure erected exclusively for broadcasting equipment.

Both the Oakland and Denver stations will be modeled after WGY, so far as equipment is concerned. They will have the same power and transmitting radius as WGY which has been heard on a single transmission in every state in the Union, in England, Hawaii and countries of South America.

Radio Beacons for Airplanes

THE Army's new radio beacon system for guiding airplanes across the country is now under development, the first unit having been put into service recently at Fairfield, O.

The new aerial radio beacon is the result of experiments conducted at the radio laboratory of the Signal Corps under the direction of Capt. W. H. Murphy, of the Army, during the past months. A model directional radio transmitter was tried out at the laboratory and found operative and was later used in practical tests at McCook Field, Dayton, Ohio, up to distances of about 40 miles. Experiments with both single and crossed loops were employed, the best results being obtained with the latter.

The apparatus to be installed at these stations will be 5-KW transmitters which will send out successive signals of a distinct type every five seconds, separated directionally by 30 degrees. That is, taking the station as a center and the exact north bearing as 0 of 360 degrees, a significant code signal, such as two dashes, is transmitted. This signal would only be audible at maximum strength for each dash on the line directly north or south of the station. Rotating clock-wise or toward the right, the station would follow the initial signal by transmitting every five seconds another distinctive signal of two dots; each successive signal indicating an angular distance of 30 degrees.

Fixed ground beacons of this type are favored for air service work against the development of special direction finding equipment on aircraft, in order to keep all special equipment on the ground, and use only standard radio equipment for communication and navigation on aircraft, saving space and weight. The system is different from light-house radio beacons in that succeeding equal strength signals rotate at the rate of one revolution per minute, whereas the light-house sends them in all directions at once.

Radio Entertainment for the Arctic Trade Posts

THOUGH icebound and in darkness through the long winter months of the North Pole, trading posts in the Arctic zone will not be entirely isolated from civilization and life. According to plans made by the Hudson Bay Company, lonely posts will be provided with radio receiving sets so as to secure entertainment at any time. Two northbound ships, the S. S. *Bayeskimo* and the S. S. *Nascopie,* are carrying Westinghouse radio receiving sets to six of the posts above the Arctic Circle.

In order to determine whether or not these posts will be able to hear the concerts from the United States next winter, the ships are listening in on their way North to the broadcasts as they steam to the frigid zone. The Westinghouse station WBZ in Springfield, Mass., gave a special concert at 11 p. m., and radiograms received from the steamship *Bayeskimo* state that the music has been heard with great success.

There are hundreds of posts spread throughout Canada and North America, from above the Arctic Circle into James Bay. The ships have left these trading posts and the factors will have their sets for next winter. Although the reports received so far from the ships are very encouraging, complete information on the results obtained will be announced upon their return.

Vindication of the Loud Speaker

JUDGE Fleischmann of Ridgefield Park, N. J., decided recently that the radio loud speaker is not a nuisance. Years ago the courts ruled that the phonograph wasn't either, so it follows logically, then, that the radio has now a clear course before it, at least in Judge Fleischmann's jurisdiction.

The particular radio set in this instance is the property of Audley Walsh of 17 Overpeck avenue, Ridgefield Park. Walsh's radio outfit was equipped with a loud speaker and it was his wont to entertain the neighborhood. As many as a hundred persons were accustomed to stand and sit in the vacant lot across from the Walsh home and listen to the music and speech. An even larger crowd listened to the Marine Band concerts and the returns from the Polo Grounds the night that Dempsey put Firpo to sleep.

Everybody seemed pleased except Louis Vander Pyl, 22 Overpeck avenue, who said that the radio was a nuisance. Vander Pyl retaliated with a phonograph which he set out on his front porch and played at nights. One night it blared for eight hours, emitting the Sextette from "Lucia" 178 times until the neighborhood entertained thoughts of murder. But even an entire night of "Lucia" did not discourage Walsh, who kept on entertaining the crowd with his loud speaking radio set until Vander Pyl appealed, without success, to the Board of Health, and later to Judge Fleischmann whom he asked to silence the Walsh radio as a nuisance.

Donald Waesche, a lawyer was retained by Walsh. Mr. Vander Pyl, although not a barrister, appeared as counsel for himself. Mr. Waesche's victory was complete. The court ruled that no nuisance was discernible and that the case was closed.

KDKA and KYW Broadcast Movements of ZR-1

WHEN the giant navy dirigible ZR-1 nosed her way out of a bank of clouds within sight of her home hangar at Lakehurst, N. J., on the morning of October 3rd, she had completed a record trip to St. Louis and return. The ship covered approximately 2,200 miles during forty-six hours actually in the air.

When the flight started from Lakehurst, N. J., station KDKA of the Westinghouse Electric & Manufacturing Company, located at East Pittsburgh, kept in touch with its progress. Arrangements had been made with correspondents in the different cities over which the dirigible passed to report by radio its movements. After the ZR-1 left St. Louis, Westinghouse Station KYW at Chicago followed its movements and gave a report over radio from its station every fifteen minutes.

Radio fans were advised approximately about the time when it would pass in their vicinity and were asked to keep in touch with KYW and let the announcer know as soon as they sighted the dirigible. This request was met with numerous phone calls and telegrams from many points along its route enabling thousands to keep in touch with its movements so that they could watch the flight.

The Hyper-Regenerative Receiver

By Arthur Van Dyke

THE purpose of this article is to describe a new adaptation of the regenerative principle for radio receivers, and since it is in accord with the best modern practice to name a new circuit attractively, the name, "Hyper - Regenerator" has been chosen for the circuit herein described. Mr. E. E. Bucher first suggested this arrangement to the author.

This receiver has some very desirable characteristics, which may be summed up in the statement that it has all the advantages of both single-circuit and two-circuit regenerative receivers, and none of the reception limitations of either. This article will show why this is true. To restate the above startling claim, it can be said that the "hyper-regenerator" is as sensitive and as easy to operate as the single circuit receiver, and has more selectivity than any two-circuit receiver now in common use.

Two standard receiving sets that are suitable for use in the hyper-regenerative hook-up

The single circuit regenerative receiver has two advantages, namely:

1. Simplicity of operation.
2. Greater sensitiveness than the usual two-circuit regenerative receiver.

The two-circuit receiver has two chief advantages, namely:

1. Greater selectivity than the single-circuit on large outdoor antennas.
2. Greater freedom from interference induced in the antenna by electric power machinery, such as elevator motors.

Simplicity of operation is had in the single-circuit receiver because there is only one circuit to tune to the desired signals. The two-circuit receiver is more difficult to operate because both of its two circuits must be in tune simultaneously before signals are heard, and there is no practical way of setting the two circuits independently of each other. The picking up of signals on this type of receiver is not easy, even for the expert operator who is familiar with each sound symptom. The two circuits make a combination much like that of a safe. The operation would be enormously simplified if there were some way that the two circuits could be tuned independently of each other as single circuits—then be put together and remain correctly adjusted. This is accomplished in the "hyper-regenerator." This, as well as the other features mentioned previously, will be explained later.

The most simple form of the new circuit is shown diagrammatically in figure 1.

The apparatus enclosed in the dash line square No. 1 is any good single circuit regenerative receiver. It has a regenerative adjustment or tickler, and a headset T_1. Signals are obtained in the usual manner in these headset telephones. The apparatus in square No. 2 is another single-circuit receiver, which may be exactly like the first one. This set is not connected to an antenna, however, but is short-circuited upon itself, that is, its antenna and ground binding posts, are simply connected together—later, an improved method for doing this will be described. The second receiver is placed beside the first one—if they are not enclosed in metal cases. The best position for it can be found by trial. A second headset T_2 is connected to the second receiver as shown or two jacks and a single headset may be used, in which case the headset can be worn continually and plugged into either circuit as desired. If jacks are used, the one in the first circuit must short circuit when the headset is removed, in order to close the plate circuit of the tube when the headset is out.

The two receiving sets then form a receiver with two circuits which, if operated in any one of several possible ways, has the performance and operational advantages stated at the beginning of this description.

Of course, if it is desired to use a loud speaker, an audio amplifier and loud speaker may be connected in place of the headset T_2 and the headset left connected at T_1. Later a method will be described, which does not require the use of a headset in either circuit, which is probably desirable in broadcast reception, whereas the one using headsets is preferable for telegraph communication, either amateur or commercial.

As described above, the necessary coupling between the two circuits is obtained by placing the two receivers near each other. Two tuners, such as the Radio Corporation Radiola Senior, or RA tuner, or one of each, may be placed side by side with good

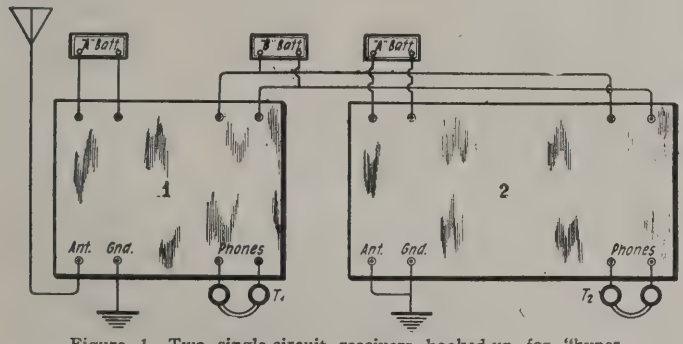


Figure 1—Two single-circuit receivers hooked-up for "hyper-regenerative" operation

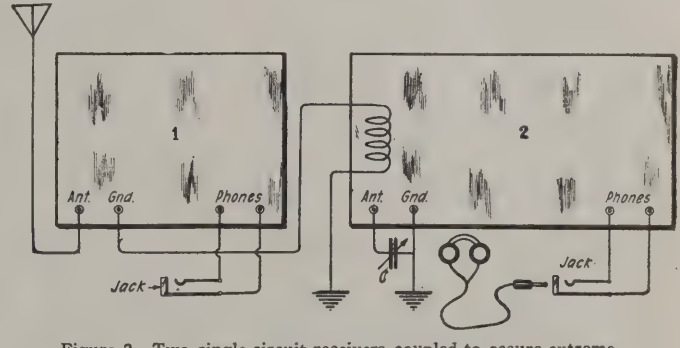


Figure 2—Two single-circuit receivers coupled to secure extreme selectivity in tuning

results. In this case, in order to vary the coupling it is necessary to move one of the sets relatively to the other. In some cases this is not convenient, and a more easily adjustable means of coupling is desirable. Variable coupling may be had by separating the two receivers by a distance of one or two feet, and providing a coil of a few (two or three) turns, which is connected as shown in figure 2. The coil can be placed inside or outside the receiver cabinet, but must be near the receiver inductance.

Figure 2 may be considered the ideal form of this receiver for reception of telegraph or telephone communication using headsets. The method of operation is to plug the headset into the first tube circuit and manip-

ulate the single-circuit receiver which is on the antenna, in the usual way. The set is then very sensitive for picking up signals. If interference is experienced, and it is desired to change to two circuits, turn on the second tube, increase its tickler coupling until the tube oscillates, and vary the wavelength control of the second set until beat notes are heard in the headset of the first set. This occurs when the secondary receiver is in tune with the primary receiver. Then decrease the tickler coupling until the receiver stops oscillating. Then move headset plug from the primary receiver, and plug into the secondary receiver. The signals will be heard immediately, and only small finishing tuning adjustments are then necessary. The coupling can be loosened to extremely loose values, far less than with the ordinary two-circuit receiver, and this increases the selectivity. Very often sufficient coupling is obtained with the two receivers—primary and secondary—placed several feet apart.

Attention is called to another detail in figure 2, namely the condenser marked "C." This is used across the antenna and ground terminals of the second receiver instead of short-circuiting them as was done in figure 1, to replace the antenna which is not used on this set. If the two sets used are identical, and one is connected to an antenna and the other is short-circuited, as in figure 1, then the tuning points on the two dials for any received signals will be widely different. Maximum convenience of operation will be had if both dials are set the same or nearly the same when in tune to the desired signals. This is accomplished by the condenser mentioned. If this is made a variable condenser, it can be adjusted until its capacity just equals that of the antenna. Then both receivers will tune at the same point on their wavelength dials. If a variable condenser is not available, a fixed condenser of the proper value will give good results. The value required is usually—to match the average antenna—300 micro-microfarads or 0.0003 microfarad. It should be noted that in the secondary receiver circuit, the condenser "C," figure 2, must be used, if the receiver is of a type which does not have a series condenser provided in its antenna circuit. All well designed receivers have this condenser, however, and it is provided in most of the modern single circuit sets.

The form of this arrangement preferred for broadcast reception may now be described. This method of arrangement is made somewhat different by the fact that an audio amplifier is necessary on one receiver —to be used as the secondary—but not on the other. The scheme is shown in figure 3. Here we may combine two receivers such as the Radiola Senior and Radiola Grand, or their equivalents. One has a suitable audio amplifier and loud speaker, and the other may have a headset, or have its "telephone" binding posts short-circuited.

In addition to the two receivers the only parts required are two single-pole double-throw switches, and a variable air condenser of 0.0005 mfd. capacity maximum. A double-pole double-throw switch to replace the two switches shown should not be used as the wiring to the switch in that case will introduce too much coupling between the circuits. Two switches must be used, connected as shown, and separated, each being near its receiver. The wiring from the second receiver to the switch and condenser must be as short and simple as possible and kept away from primary circuit parts and wires.

In figure 3 the coupling between circuits is obtained between the receivers themselves, no coupling coil being shown. It is often desirable to use a coupling coil, however, as in figure 2, in order to vary the coupling easily. The same batteries can be used for the two receivers, although with WD-11 tube sets, it is better to use separate filament batteries.

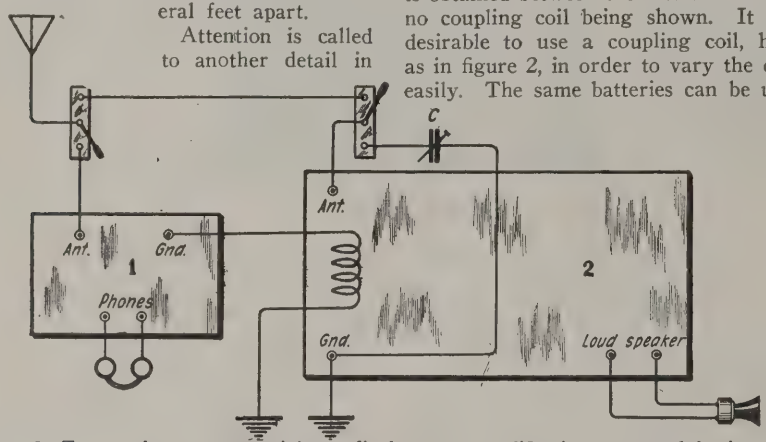


Figure 3—Two receivers, one containing audio frequency amplification, connected for improved broadcast reception

The mode of operation of this arrangement is as follows: For picking up signals and for usual operation when severe interference is not present, the simple single-circuit connection may be used. For this the two switches are thrown up. This puts the antenna on the secondary receiver which has the audio amplifier and loud speaker, and which is then operated in the usual manner, as a single-circuit regenerative receiver. When it is desired to obtain greater selectivity, the switches are thrown down. Then the tube of the first receiver is lighted and its control—wavelength and regeneration—adjusted, and also the condenser "C" adjusted until signals are heard and tuned in. Also at this time the tickler of the secondary receiver must be reduced usually because the resistance of the secondary circuit is less than that of the antenna circuit so that less regeneration is required. Note that condenser "C" is to be varied in the secondary tuning circuit, and not the wavelength control of the receiver. This is to be done the first time a signal is tuned in after connecting up the apparatus as shown, and is unnecessary thereafter. It will be seen that if a signal is tuned in with the switches up, in which condition the secondary receiver is connected to the antenna, and then the switches are put down and condenser "C" varied until signals are again in tune, condenser "C," having replaced the antenna, must be exactly qual to it. After this is done once, it need not be done again, condenser "C" may be left locked in position, and all later tuning of signals is even more simple. The process then is: Put switches up and tune in signals on the secondary receiver. To change to two-circuit operation, put switches down, decrease secondary receiver tickler coupling somewhat—if it was up pretty well before—and adjust the primary receiver wavelength and tickler controls.

There are several methods of operation, other than the one described, and some of them may appeal to certain readers more than the one described. It is not desirable to describe all these methods in this article. It should be possible for each experimenter to study out the method he likes best. The fundamental theory of the arrangement should be kept in mind. It is a two-circuit receiver, differing from the ordinary two-circuit type in the important respect that both circuits are regenerative, instead of only one, as in the ordinary two-circuit regenerative receiver. Since the effect of regeneration is to reduce the effective resistance of a circuit, when both circuits are made regenerative both circuits have, and therefore the whole system has, very low resistance. The ordinary two-circuit regenerative receiver reduces the resistance of the secondary by regeneration, but not that of the primary to any extent. Since the sharpness of tuning, the selectivity, in ordinary two-circuit receivers, depends very largely upon the resistance of the system, being greater as the resistance is less, it is increased materially by use of this arrangement. Use of looser coupling than customary with two-circuit receivers is also possible and this adds to the selectivity.

Looser coupling also adds to the nicety of operation in several ways. For example, with such loose coupling, tuning of either primary or secondary does not affect the other, and there is no mutual dependence, due to reaction, as in the ordinary receiver. This is especially valuable in C. W. telegraph reception where pitch of beat note is not affected by primary circuit adjustment. The "hyper" connection can be used as an ordinary two-circuit receiver, of course, by not lighting the tube of the first receiver. The set is then equivalent to an ordinary two-circuit receiver, and the enormous improvement in the hyper arrangement is obvious as soon as the tube is turned on and its tickler adjusted. Another way of looking at this arrangement is that the tube in the first receiver is a stage of radio frequency amplification. But since it is tunable, it is a very efficient radio amplifier stage, and is about equal to two stages of broad transformer coupled radio amplification.

The arrangement which has been described has the same sensitiveness, or slightly greater, perhaps, as the single circuit receiver. Greater sensitiveness can be obtained by more complicated connections of two receivers than are used in the arrangement shown here, but it is believed that this arrangement is the best, because of its simplicity, and ease of operation accompanied by selectivity of very high degree. The selectivity of this method is, in fact, the greatest that it is possible to obtain by methods dependent upon resonant tuning, and the excellent results obtained by its use will satisfy even very exacting experimenters and broadcast listeners.

Some Notes on Receiving Antenna Resistance

By Samuel C. Miller

THERE has been quite a bit of confusion in the mind of the amateur in regard to the factors which cause and make up the resistance of an antenna system. Due to the amateur's lack of knowledge as to these factors, he will go into unnecessary expense in the construction of the antenna system without obtaining any benefit whatever. This holds true even for those who have had a good electrical training because it is not realized that the phenomenon of high frequency or radio frequency is different than that obtained in a simple direct current, or 60-cycle alternating current, circuit.

In a direct current circuit, if two factors are known, then the third can be easily obtained by simple calculation. For instance, in figure 1, there is shown a dry cell connected across a lamp and coil in series. An ammeter is also placed in the circuit to read the current. The dry cell has a terminal voltage of 1.5 volts, the lamp a resistance of 1.0 ohm and the coil a resistance of 0.5 ohm. The current flowing in the circuit can therefore be found because the voltage and resistance are known. Using the formula $I = \frac{E}{R + R_1}$ where E is the voltage of the cell, R the resistance of the lamp and R_1 the resistance of the coil $I = \frac{1.5}{1 + .5} = 1$ ampere. This can be checked by the ammeter in the circuit.

A 60-cycle alternating current circuit is shown in figure 2. It consists of 110-volt supply across a 10-ohm lamp and a coil which has a wire resistance of 5 ohms and an inductance of 0.1 henry. The current flowing in the circuit as indicated by an A. C. ammeter can be solved by using the formula $I = \frac{E}{\sqrt{R^2 + X^2}}$ where E is the voltage, R is the ohmic resistance of the lamp and coil and X the reactance of the coil. The reactance is found from the formula $X = 2\pi fL$ where f is the frequency and L the inductance. Therefore $X = 6.28 \times 60 \times .1 = 37.6$ ohms. With the reactance = 37.6 ohms and the resistance = 15 ohms therefore $I = \frac{110}{\sqrt{15^2 + 37.6^2}} = 2.7$ amp.

To those unfamiliar with alternating current or direct current theory, it is my point not to give a lesson in the subject of solving problems, but to show that in direct current and low frequency alternating current circuits, it is comparatively simple to solve a problem to find a factor when the other factors are known. This can be accomplished with formulae readily available. However, in radio circuits, which deal with high frequency alternating currents and especially in that branch consisting of the antenna system, only very indefinite general laws are available and the calculation of each antenna system must be made separately. For instance, there are two antenna systems each having the constants as shown in figure 3; that is, each system has a 100-foot horizontal wire of the same diameter wire and identical 50-foot lead-ins. One antenna is located 25 feet above an apartment house while the other antenna is located 25 feet above grassy ground. On measuring the resistance of each it will be found that the resistance of the system located on the apartment house will be much higher, in fact, two to three times that of the antenna system located above the grassy ground. This seems surprising because they are identical in construction, even to the size of wire. If direct current or low frequency alternating current theory was applied, the two would give equal resistance results. But in dealing with radio frequency new factors enter which are more important than the ohmic resistance of the wire.

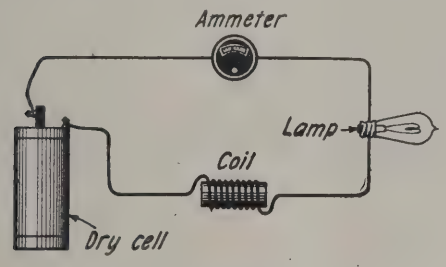


Figure 1

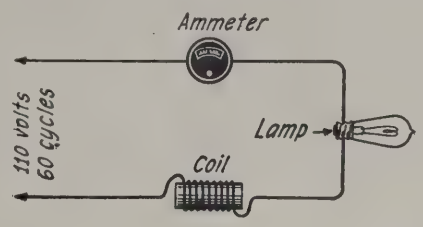


Figure 2

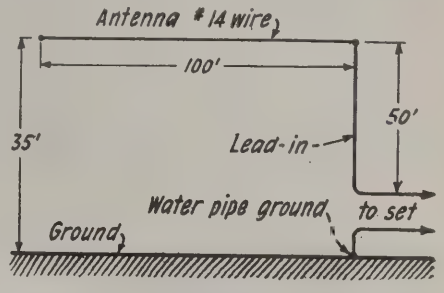


Figure 3

Methods of determining resistance in various circuits

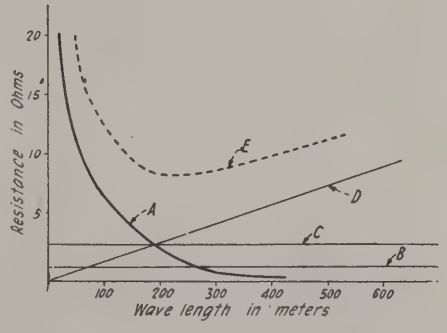


Figure 4—Graphs showing wavelength and resistance

As in a transmitting antenna system, a receiving antenna system can be said to dissipate the power absorbed by it, in four ways: first, radiation resistance; second, ohmic resistance of the wires; third, ground resistance; fourth, dielectric resistance.

The first of these, radiation resistance, represents the only useful agent, as upon it depends the amount of power that is actually impressed on the receiving circuit. This is represented in figure 4 by curve A. Figure 4 is a chart where the resistance is indicated on the ordinates and the wavelength by the abscissa.

The next source of dissipation of power is that due to the ohmic resistance and includes the losses in the antenna and lead-in wires. Because of the eddy current and skin effects due to the high frequencies in the wire, the resistance will vary with wavelength, but as the losses caused are small, the ohmic resistance can be taken as constant, irrespective of wavelength. It is therefore represented by a straight line "B" in figure 4.

The ground resistance is also an ohmic resistance and depends on the location of the station. Stations near water and good moist or grassy grounds will have a lower ground resistance than stations located on sandy or rocky ground. The straight line "C" in figure 4 is shown as a resistance which is constant irrespective of wavelength.

The dielectric resistance is caused by a dissipation of power through dielectric absorption. This is due to the fact that the antenna capacity is an imperfect condenser and therefore losses occur in the medium between the antenna wire and lead-in as one side and the ground and other masses such as buildings, iron pipes, etc., as the other side of the condenser. It is in this dielectric resistance where most of the losses occur in the average antenna systems and which constitutes most of the resistance, making the other factors, ohmic and ground resistance small as compared to it. The dielectric resistance is indicated by curve "D." For example, it has been found that the dielectric losses due to an antenna lead-in running parallel for a short distance to a grounded iron pipe caused a great increase of resistance in the antenna system. As any increase of antenna resistance means decrease in signal strength, it can be seen that it is important to keep down the resistance due to dielectric losses.

Going back to the comparison made earlier

of two identical antenna systems, one placed over a grassy ground and the other over a building, the reason becomes apparent why the antenna system over the apartment house will have a higher resistance than the one over a grassy ground. The ohmic and ground resistance in each case is the same, but the dielectric losses in the concrete and iron of the apartment house will be very much higher than the losses occurring in the air between the antenna and grassy ground. The resistances in the apartment house antenna will be divided approximately as follows: Ohmic resistance = 1 ohm; ground resistance = 2 ohms; dielectric resistance = 25 ohms; a total of 28 ohms, which is average for such an installation. On the other hand, the antenna over grassy ground will have approximately 3 ohms for ohmic and ground resistances and only 6 ohms for dielectric resistance, giving a total of 9 ohms which is representative of this type of installation.

Many suggestions have been submitted at various times for decreasing receiving antenna resistance by using heavier antenna wire or twisting many wires into a cable. If the antenna system were to be used for transmitting or for reception on the higher wavelengths, considerable gain would be obtained by careful choice of wire and form of flat top. But for reception on the shorter wavelengths, any decrease obtained in the ohmic resistance of the antenna is so negligible compared to the existing dielectric resistance that the extra expense involved is actually a waste of money.

In general, when constructing an antenna system for reception on short wavelengths the ideal is one consisting of a single wire 100 feet long and 25 feet or more above a grassy ground. Such a system has approximately a fundamental wavelength of 200 meters, a capacity of .0005 mfd. and a resistance of 10 ohms.

Certain precautions, however, should be observed in the construction of the antenna system in order to keep the dielectric losses, and therefore the resistance, as low as possible.

First—Keep the antenna and lead-in wires as far as possible away from buildings and grounded metallic conductors such as iron drain pipes, fire escapes, iron chimneys, etc.

Second—Be sure the ground lead is solidly connected to the ground, whether it be the radiator, water pipe or any other metal going into the earth. The best thing is to solder this connection, keeping in mind that solder will not hold if there is any grease or dirt on the point of contact. Be sure and scrape off any paint or foreign material before making this connection.

Third—Whenever possible stretch the antenna over a grassy ground and avoid bringing it close to buildings or trees. When connecting the antenna to a tree, bring the wire to a distance of about 8 or 10 feet from the tree and then insulate and guy the rest of the way to the tree. This should be carefully observed especially when using bare copper wire. If the antenna wire is brought in among the branches, a large loss will occur, particularly in rainy or damp weather.

A Method of Continuous Wave Transmission on 100 Meters

By F. W. Dunmore
Associate Physicist, Bureau of Standards

AT the request of the Chief of the Air Service, the Bureau of Standards undertook an investigation on a method of continuous wave transmission at 100 meters. The operation of electron tube transmitting sets working at longer wavelengths than 150 meters has been carefully studied by many radio experimenters, but methods of transmission at 100 meters and the nature of such transmission over any considerable distance has not been much investigated up to the present time. It is the object of this report to describe the method developed, the details of the circuits used, and the results of some of the tests made over distances up to 300 miles.

Type of Antenna

As a coil antenna is an effective radiator when the ratio of wavelength to coil dimensions is not large, and since a coil antenna is a somewhat directive radiator, an antenna somewhat on this order was developed. It is a combination of the capacity type and the coil type of antenna. The power is coupled in at the center of the lower horizontal section of the antenna. The antenna consists of a number of wires in parallel in the form of a rectangle with a gap in it. The antenna thus includes substantially a single-turn inductance coil and a condenser. The condenser is formed by covering the two wooden spreaders with copper foil. The glass rods between the two spreaders are efficient insulators. The parallel wires composing the antenna are 23 No. 20 B. & S. gauge bare copper wires connected in parallel and spaced three inches apart. Light wooden spreaders are placed about every 4 feet in order to keep the wires separated. The size of the antenna is 18 feet high and 40 feet long. The above combination, with the three-turn secondary coil connected in series, forms a circuit with a wavelength of 105 meters.

The circuit used was somewhat similar to the Meissner circuit. Western Electric type G 50-watt tubes were used, four of these being operated in parallel. With this combination about 6 amperes at 105 meters were obtained in the antenna. The tubes were found to operate more satisfactorily with 32,000 ohms shunted by a 0.002 microfarad condenser connected in the grid circuits. A similar condenser shunted by a 50-ohm resistance, in the high voltage supply circuit, helped to stabilize the operation of the tubes. For operation at 105 meters, it was found that the primary or plate coil "B," should consist of two turns of heavy copper strip 2 inches wide. This coil, shunted by a 0.002 microfarad mica transmitting condenser, gave the required wavelength of 105 meters.

For the grid coil a 14-turn helix was used. A tap at 5½ turns from the center gave best operation. The coupling between this coil and the plate coil was rather critical.

To transfer the power to the antenna, a secondary coupling coil was used. This coil consisted of three turns of brass strip, 1 inch wide. This coil was connected in series with the antenna.

For interrupting the continuous wave, for I. C. W. work, a chopper was used. This chopper was connected in series with the lead from the filament circuit to the radio-frequency circuit.

Results Obtained

Numerous tests have been made with this type of short wave transmitting set. Mr. Frank Conrad, of the Westinghouse Electric and Manufacturing Co., has kindly co-operated with us in making these tests by arranging to have an operator listen at his station, 8XK, in East Pittsburgh, Pa.

To date five tests have been made with the above station. The first two tests were made at night. Signals were reported as received at East Pittsburgh with an audibility of approximately 1,000 on a detector and one stage of audio amplification. An interesting fact in connection with these tests was that there was practically no fading. The above tests were also heard at Boston, Mass. Two-way communication was maintained with the 8XK station on both tests.

The evening tests were so satisfactory it was decided to investigate the daylight transmission effects. Continuous tests were therefore made on two occasions starting at 12 o'clock noon and running into the evening up to 10 p. m., in order to compare the relative signal strength of day and night transmission. It was expected that at such short wavelengths the received signal strength would be much less during daylight than at night.

The results of the first daylight-darkness tests were as follows: The signal strength at 8XK was reported to be about 100 audibility both during the day and evening. A detector and one stage of audio-amplification was used for reception. The fact that the signal strength was the same during the day as in the evening is a very interesting one as, at short wavelengths especially, it has been held that the absorption would be much greater during the daytime than at night. No conclusions can be drawn upon this point until a number of tests have been made. The weather was rainy at the transmitting end and cloudy at the receiving end on the day of the first tests. Another interesting point which was noted was the lack of fading. Further tests are needed to confirm the results with respect to this unexpected condition.

(*Continued on page* 59)

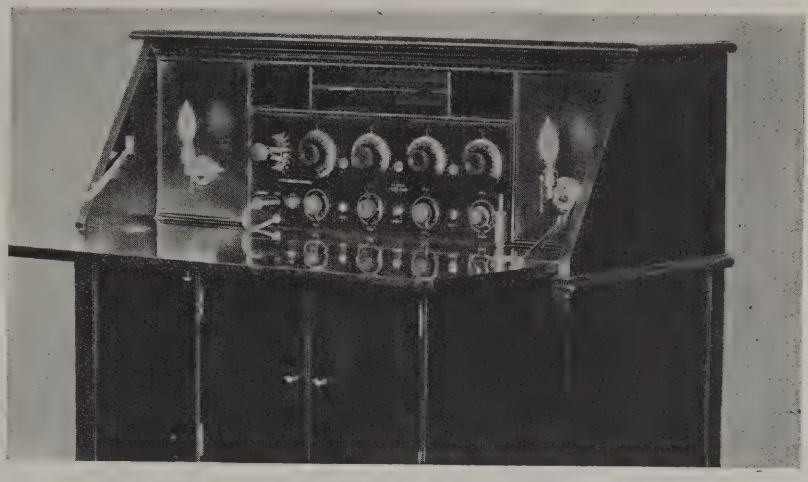
Tuned Radio Frequency Amplification

A Reactance Capacity Coupled Circuit Remodeled to Suit Present Broadcast Reception Suitable for Use With a Loud Speaker on Distance as Well as Local Reception

By Leon W. Bishop, 1XP

RADIO frequency amplification has been the subject of much discussion for ten years, but it is only in the last few years that we have been able to get good results on the shorter wave bands.

Fully 90 per cent. of the radio frequency circuits employ transformers of fixed ratios for a given wave band and in some instances use iron to broaden the range. No matter what method is used to broaden the band with a fixed ratio transformer, there is still one band that is favored while the efficiency drops off rapidly on either side.



A tuned radio frequency amplifying receiving set designed by the author

There is no need of a double circuit tuner when several stages of tuned radio frequency are used and where a slight amount of regeneration is present. In figure 1 let the dotted line represent a given wavelength and point A the tuning point of the single circuit. If the first tube is tuned to this exact point, regeneration will occur, but a place on either side of A will be found where no regeneration occurs and the amplification is normal. The point C represents the tuning peak of the second tube and it may be seen that the relative positions of B and C may be reversed so as to minimize interference from local sources. The third stage is shown by D and is not critical of tuning, due to the great amount of amplification delivered to it by the first two stages, however a wide range of selectivity may be obtained by using this stage in connection with the second.

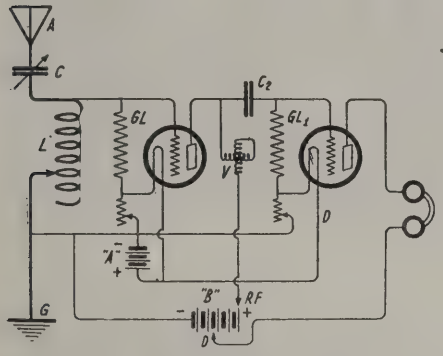


Figure 1—One stage of radio frequency and detector circuit

Figure 2 shows one tuned stage of radio frequency and detector. The variable condenser C is .0005 mfd. (23 plates). The tuning inductance L consists of 60 turns of No. 22 wire wound on a four-inch tube and tapped every 10 turns. V is a variometer and should be free from shellac on the windings. The success of this circuit depends upon the grid leaks and for that reason it is best to use a variable grid leak. The first grid leak GL is about one megohm, and the second or detector grid leak GL_1 is about one-half megohm. The grid condenser C_2 is of the mica type and .0005 mfd.

The high vacuum type of tube is best for the radio frequency circuits, while the standard type of detector tube is best adapted for the detector circuit. The B battery for the first radio frequency tube should be from 45 or 67½ volts, and the detector voltage should be that amount recommended by the manufacturer for the particular tube used.

The grid leaks should be adjusted to the point where only a small path of regeneration occurs when tuning the variometer. A variometer may be used in the plate circuit of the detector tube with increased amplification, but also increased tuning troubles.

Figure 3 shows three tuned stages and detector. The aerial circuit is the same as that described in figure 2. The fixed condenser C_1 of .001 mfd. is of the mica type. The grid leaks on the first and second tubes should be capable of adjustment as low as 10,000 ohms. A 300 or 400-ohm potentiometer P is connected across the A battery and the negative B battery returned to it. A separate tap is provided for the first stage of radio frequency while the second two stages are connected to the same point on the positive B battery. As much B battery as possible should be used on the radio frequency tubes up to about 90 volts. The proper amount is determined by trial.

The phones should be shunted with a .002 mfd. condenser, to prevent capacity feed back.

For those interested in power amplification, figure 4 shows three stages of radio frequency and two stages of audio frequency amplification. The radio frequency part of the circuit is the same as that shown in figure 3. The fixed condenser C_3 is .002 mfd., the point X to be connected to the negative side of the filament and not to the negative side of the A battery.

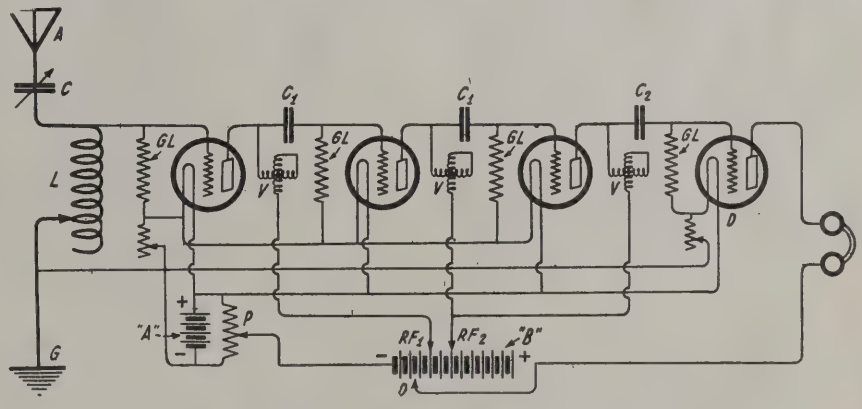


Figure 3—Circuit diagram of a 3-stage radio frequency and detector set

Figure 5 shows an outline of the panel, which is 22 x 8 inches, for those wishing to follow the design.

The results obtained with this circuit depends upon two points, first, the adjustment of the grid leaks, and second, your knowledge of tuning.

Radiotron 201-A tubes are the best for all of the amplifiers, and may be used for the detector, but the old standard detector tube UV-200 with proper plate voltage, seems to give the best results. When distance reception is the object, the voltage on the plate of the first radio frequency tube should be lowered, but when volume is desired this should be increased.

The dials should be set to correspond with the variometers. That is, the dial should be at zero when the variometer is at minimum, as readings obtained on various stations have a meaning and the same station will always appear at a given point providing the values of the grid leaks have not been changed in the meantime.

When the circuit is first used regeneration will run wild, but this can be controlled by decreasing the grid leaks. The leak on the second tube is most critical and is always the lowest, sometimes in the order of 10,000 ohms. As the leaks are decreased tuning becomes broader, but it is advisable to have a path of regeneration on the first variometer. When regeneration enters into this circuit it comes on with a bang and all signals stop. The greatest signal strength is obtained on either one side or the other of the regenerative point and close to it.

Once a rough setting of the grid leaks are obtained the third variometer dial can be set at 75 and the second dial at 40, tuning the first variometer and aerial condenser to a given signal, using both hands in the operation. The tuning may be finished up by a final setting of the second and third variometers.

The most active part of the first variometer dial is the first eighth of the dial, the second variometer the middle half and the third is active over the last half. This is the normal condition, but many variations may be tried that are more selective.

While various points of regeneration may be found, it must be remembered that this type of regenerative set will not produce interference with other receivers in the neighborhood.

This circuit is taken from the old British practice of reactance capacity coupling and remodeled to suit our present broadcasting reception. The circuit is designed for use with a loud speaker on distance reception as well as local. Stations 1,500 to 2,000 miles away may be reproduced in the loud speaker with wonderful volume and no distortion. Indoor types of aerials may be used with success and also loops for local work. This set greatly reduces interference from local stations as well as static.

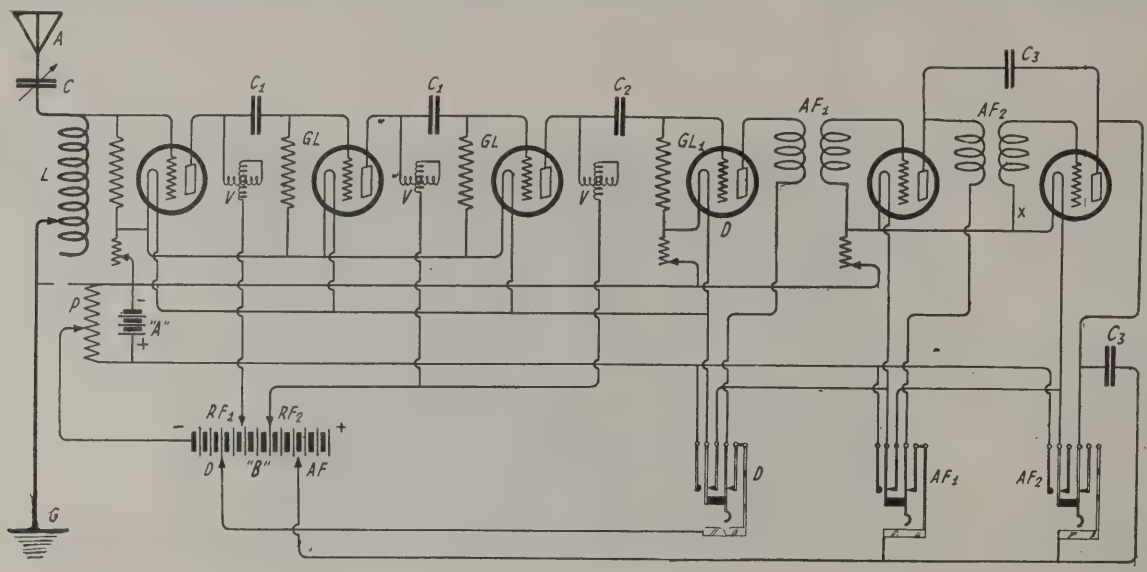


Figure 4—Circuit diagram of a six-tube set having 3 stages of tuned radio frequency, detector and 2 stages of audio frequency amplification

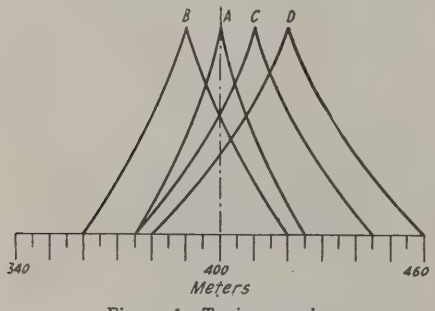


Figure 1—Tuning graphs

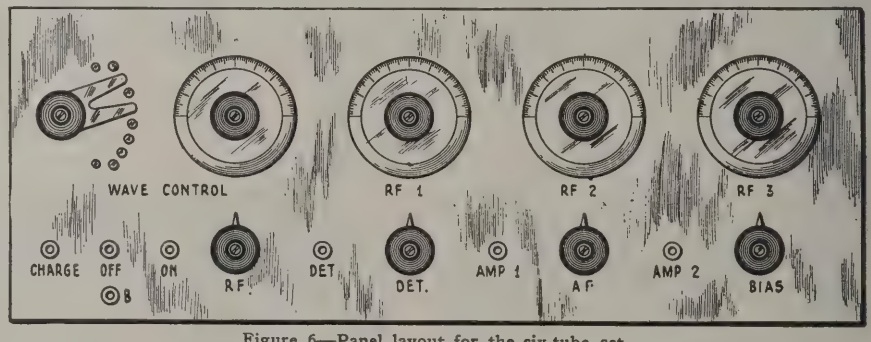


Figure 6—Panel layout for the six-tube set

Key to Diagrams—A, aerial; A, A battery; AF, audio frequency; B, B battery; C, .0005 variable condenser; C_1, .001 fixed condenser; C_2, .0005 fixed condenser; C_3, .002 fixed condenser; D, detector; G, ground; GL, grid leak; GL_1, detector grid leak; L, tuning coil; P, potentiometer bias; RF, radio frequency; V, variometer.

Civil Service Examination for Telegraph Operators

THE United States Civil Service Commission announces an open competitive examination for telegraph operator to fill vacancies in the Bureau of Agricultural Economics, Department of Agriculture, at an entrance salary of $1,400 a year, plus the increase of $20 a month granted by Congress, and vacancies in positions requiring similar qualifications.

Applicants must have had at least two years' experience as telegraph operator, such experience to have been acquired with any of the large commercial telegraph companies, with any of the land wire associations, in the general relay office of any large railroad, or with any private concern operating a leased-wire service, such as newspapers, brokers, packing houses, etc.

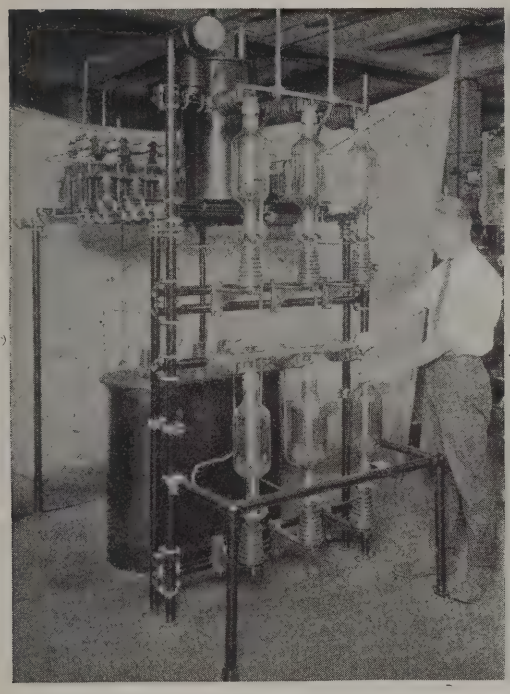
Competitors will not be required to report for examination at any place, but will be rated on their education, training, and experience, on a scale of 100, such ratings being based upon competitors' sworn statements in their applications and upon corroborative evidence. All applications must be in by December 28.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil-service examiners at the post office or custom house in any city.

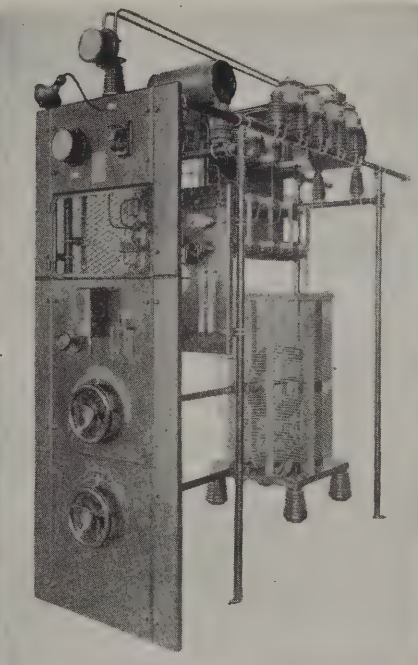
Six More Stations for United Fruit Co.

Powerful 20 K. W. Radiotron Transmitting Sets to Be Installed in Central America and the United States to Perfect a Communication System Between the Americas

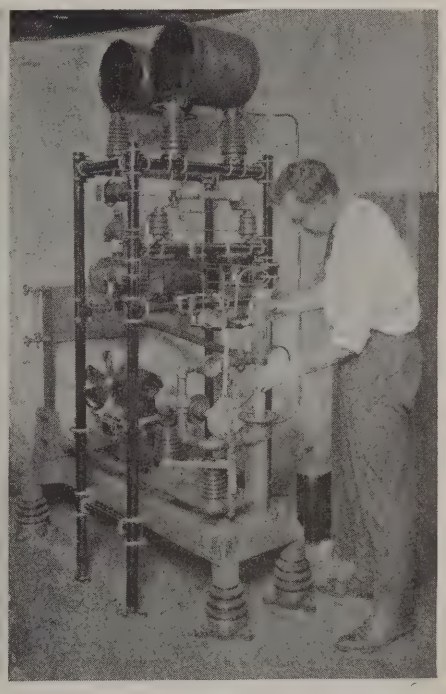
SIX vacuum tube radio transmitters, to be the most powerful stations of this type on the American continent, and first to make use of the General Electric 20-kilowatt Radiotron, are being installed by the United Fruit Company and the Tropical Radio Telegraph Company at points in Central America and the United States for the purpose of completing the links of an adequate communications system between the Americas. These transmitters will be located at: New Orleans, La.; Miami, Fla.; Puerto Barrios, Guatemala; Tegucigalpa, Honduras; Managua, Nicaragua, and Almirante, Panama.



Kenotron rectifier unit of the 20 K. W. transmitting set



The master oscillator for use with 20 K. W. transmitting equipment



20 K. W. water cooled tube unit

The Tropical Radio Company operates the stations at New Orleans, Miami, Tegucigalpa and Managua, while the stations at Puerto Barrios and Almirante are operated by the United Fruit Company.

The first of these six sets has just been completed at the Schenectady works of the General Electric Company and will be shipped within a few days to the Tegucigalpa station. The other five are scheduled to be completed and shipped at the rate of one a month. About two months will be required to install each set and it is therefore expected that all six will be in operation by the middle of next year.

The United Fruit Company established the first radio stations in Central America and was the first to establish commercial radio communication between Central America and the United States in 1904. The operation of these stations convinced the directors of the United Fruit Company that radio was practical and valuable in a business which handled such a highly perishable product as the banana. So the year following, or 1906, stations were opened at Bluefields and Rama, Nicaragua. All these stations, because of the lack of land communications, handled, in addition to the company's business, a large share of the telegraph business of the general public between these places and the United States and Europe. Other stations have followed since then until now, with the six new tube transmitter stations, there will be a total of nineteen, comprising the United Fruit Company's radio system. All stations of the United Fruit Company's system, including all their ships of the "Great White Fleet," are to be equipped with tube transmitters of a similar type.

The United Fruit Company has spent more than $3,000,000 in the development of its radio system and upon the completion of new stations under construction its investment in radio will probably exceed $4,000,000. Since 1911, the radio activities of the company in all its branches have been under the immediate direction of George S. Davis, who is general manager of their radio telegraph department. He is also president and a director of the Wireless Specialty Apparatus Company, general manager of the Tropical Radio Telegraph Company and a director of the Radio Corporation of America.

In the operation of these transmitters, in some cases where stations are located in remote places, the primary power is generated at the station by gas or oil engine driven alternators supplying 220 volts. In other stations the power is obtained from the distribution system of local power companies. This power first goes to the service panel where complete apparatus for control, protection and metering is installed. Then it goes to the rectifier, which consists of a bank of transformers and six, twelve and one-half kilowatt kenotrons. Here the voltage is stepped up and rectified, to become 15,000 volts direct current. This high voltage is then used for plate power on the pliotron oscillators.

The frequency is controlled by means of a master oscillator employing a one-kilowatt pliotron. The master oscillator provides a lower power radio frequency supply, which is then amplified to twenty kilowatts of power by means of one of the new water-cooled twenty-kilowatt tubes. The amplified power is passed through a tank circuit which eliminates harmonics and is then fed into the multiple tuned antenna. Keying is accomplished by means of a relay on the master oscillator unit. This relay may be controlled from any desired distance and is adapted to keying speeds up to sixty words per minute.

Minerals That Are Used As Crystal Detectors

By Dr. E. Bade

THE electrical properties of certain minerals and crystals, which permit a high frequency current to flow more freely in one direction than in another, have made the crystal detector receiving set universally popular, especially near a broadcasting station. A fragment of such a mineral, adapted for this work, rectifies the high frequency radio waves, and it is this unilateral conductivity, with its one direction current, which actuates the phones, in other words, it changes the radio-frequency waves into audio-frequency waves.

In order for the mineral to do this, it must possess certain properties. In operation it must resemble a valve which permits a flow when there is pressure in back of it, but it must shut off this flow, when the pressure is released, that is, it must prevent a return flow. This is accomplished by the internal structure of the crystal detector.

The most common of such minerals which have this inherent "valve-like" property, are the sulphur compounds of the heavier metals of lead, copper, iron, and molybdenum. The sulphide of lead is about the most sensitive crystal, as it rectifies the radio-frequency currents much more thoroughly than any other mineral, although some of the new synthetic crystals are quite good for this purpose.

Galena, the sulphide of lead, is the peer of all crystal detectors. Usually only a fragment of the mineral is taken, the fracture of the break cleaves into three different planes which are at right angles to each other. This cubic cleavage, as it is called, is demanded by its structure, for, it is composed of an almost infinite number of minute particles which have a regular arrangement and relation to each other. These tiny, minute particles have, in the course of time, gradually been brought together, and, like a structure, which has been built up block by block, so the crystal has formed and increased in size by its own individual "blocks."

Not every piece of galena is sensitive to radio reception, one face or the other being valueless for this purpose. By turning the mineral around, a sensitive spot may be found. If this does not help, simply splitting off a thin sheet on one side will usually lead to the desired result. Never throw a crystal away simply because a sensitive spot cannot be found. Take a sharp pointed knife and split off a fragment uncovering a fresh and untarnished cleavage surface. Nine times out of ten this will produce the desired effect. A piece less than 1/16 of an inch gives far better results, at times, than a thicker, chunkier piece, although this is not always true. A piece of galena must be tested before it can be said that it is sensitive.

Galena not only finds a restricted use in radio reception, but it is of far greater importance as an ore for lead, sheet lead as well as pipes, etc., being made from it. One third of the annual production of lead is used in making paints and is permanently lost. But strange to say this important metal is not so much mined for its content of lead, as for the silver which is associated with it, the lead being only an incidental product of manufacture.

Another sulphide used for radio but of little commercial importance, is that of iron, the pyrite as well as the marcasite. The former are cubic while the latter are spear-shaped. Both are but slightly sensitive.

The sulphides of copper are sometimes used for detectors in radio reception. Chalcopyrite and bornite, both important ores for copper, are comparatively rare in crystal form. These two types of minerals have been successfully used for rectifying high frequency currents of radio waves.

A sulphur compound of molybdenum, molybdenite also has the property of unilateral conductivity and can therefore be used as a detector. This lead-gray mineral, metallic in appearance, is seldom found in large quantities, and is quite difficult to obtain. It is one of the more important ores for this element which finds its greatest use in the hardening of steel, as a fireproofing material, and as a coloring matter for rubber and leather.

The oxide of zinc, zincite, primarily found in New Jersey, has been one of the

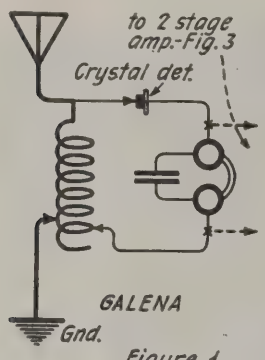


Figure 1

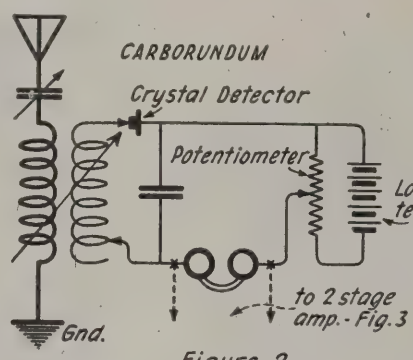


Figure 2

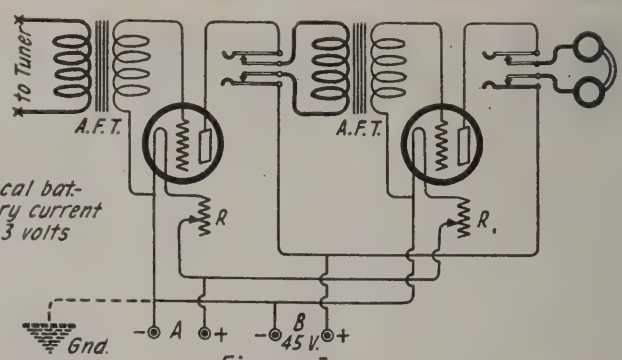


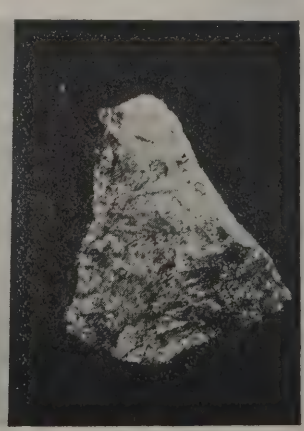
Figure 3

Receiving circuits using crystal detectors and two-step audio frequency amplifying unit

Marcasite

Carborundum

Galena


Silicon

more successful minerals used as a crystal detector. In fact, when a fragment of zincite, or a tiny crystal of it, is placed in contact with either chalcopyrite or bornite, the well known Perikon detector is produced. This combination is very successful, in fact some persons prefer this type to galena, the more universal detector. To make a detector of this type, take a larger fragment of the copper ore, embed it in a low melting alloy and place in the detector cup. Mount the tiny crystal of zincite in a similar way on the rod carrying the cat-whisker or mount it on a short piece of wire and attach this in place of the cat-whisker. The point of the tiny zincite crystal is then brought in contact with the copper mineral whereupon rectification will occur.

Another mineral having unilateral conductivity is cuprite, a copper oxide. It is not especially valuable as a detector, but it is important as a copper ore.

A detector widely employed by the Marconi company, until recently is cerusite, a lead carbonate. It has been formed by the decomposition of galena by waters charged with carbon dioxide gas and as such it is found on top of galena itself. This mineral is of great importance as a source for lead.

Some of the rarer elements can also be used as rectifying detectors. One of little commercial value, but finding a restricted use as a detector is tellurium. This is a very rare mineral element producing small hexagonal crystals and are primarily found in Colorado and in Transylvania. Arsenic has also been used for this purpose, although the crystals, which occur free in nature, are comparatively rare.

The non-metallic boron is never found free in nature, but still it can be used to rectify high frequency currents. The element is prepared by heating the chloride of boron in an atmosphere of hydrogen to a very high temperature. The resulting pure boron is dark gray in color and almost as hard as a diamond. In this condition it can be used as a detector.

Crystallized silicon is another artificial rectifier of radio frequency waves. This element is considered second in importance to galena as a detector. Next to oxygen it is the most abundant element and still it is never found free. By igniting a mixture of pure sand and magnesium in a clay crucible, amorphous silicon is obtained by the sudden reaction which occurs, the entire mass developing intense heat. When cooled, white magnesium oxide which is soluble in dilute acids and amorphous silicon which remains unattacked, is produced. The crystalized silicon is obtained by adding the silicon powder to molten zinc or aluminum. Here it dissolves, and on cooling, octahedrons or crystal leaves are formed. These can be obtained by dissolving the metal in acids whereupon the silicon remains. On a commercial scale it is prepared by heating a mixture of coke and sand in an electric furnace to a very high temperature. Carbon monoxide is given off and silicon remains as a silvery, metallic appearing substance highly crystalline and very brittle.

Crystals of carborundum, the silicide of carbon, also possesses the peculiar property of unilateral conductivity. It is prepared like silicon, the difference being that more coke is employed and the heating continued for a longer period. Silicon is the product first formed, but this silicon again reacts with the excess carbon present uniting with it. This is carborundum, and appears as beautiful purplish black crystals of extreme hardness. When this artificial crystal is employed as a detector for the rectification of high frequency currents, it is advisable to employ a small constant potential across the terminals. This will increase the sensitiveness of the compound.

Figure 1 is a simple crystal receiving apparatus using silicon, galena or synthetic crystal without a local battery current and figure 2 shows a similar type using carborundum or zincite bornite crystals which depend upon the combined effects of the receiving energy and a local battery current for effective reception. While code signals of a damped wave character can be received over considerable distance with a receiving apparatus of this kind, undamped or C. W. signals cannot be converted into audible sounds. Modulated or voice signals (broadcast) can be received from stations within a thirty-mile radius provided that head phones are used. For sufficient volume to operate a loud speaker with the types shown in figures 1 and 2 a two-stage audio frequency amplifier, figure 3, should be added. Comparing the receiving range of this apparatus with a vacuum tube detector, in place of the crystal it is found that the tube is superior in long distance reception. However, the crystal gives much clearer and undistorted signals.

Figures 4 and 5 show the crystal detector employed in the reflex circuit. Regardless of the crystal employed a local battery current is not supplied. The crystal here acts as the detector after the incoming current has passed through the radio frequency amplifier, but it has nothing to do with the volume of the detected and rectified signals. The audio frequency circuit figure 3, can be used effectively in circuits 4 and 5 in producing greater volume.

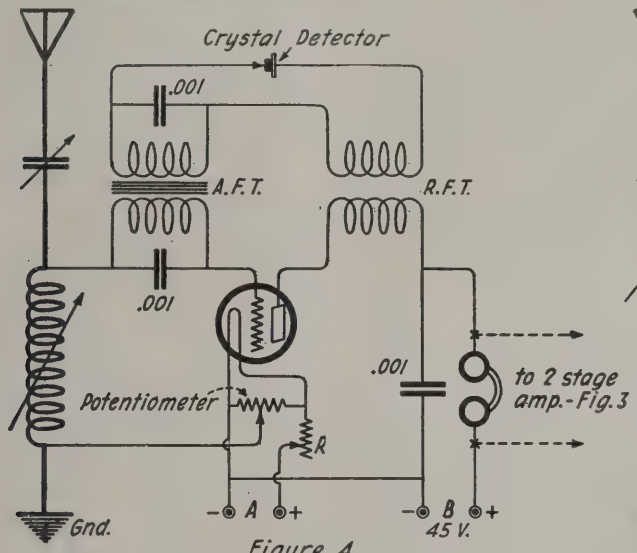


Figure 4

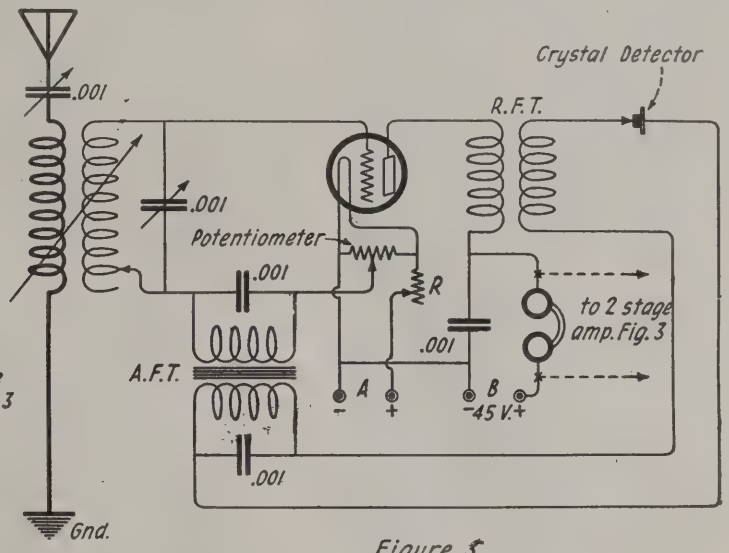


Figure 5

Circuit diagrams of reflex receiving sets

The Deaf Hear With Radio Amplifiers

ACCORDING to a recent dispatch from London, a 77-year-old man, who has been deaf for thirty years, has heard once more through the use of radio receiving apparatus. Tests conducted at Marconi House, London, indicate that not only this man but a great many others, including some who have been deaf from birth, are able to perceive music when amplified to great volume by means of radio amplifiers.

Some of them actually hear the sounds, if any portion of their auditory nerve is active, no matter how deeply buried within the head it may be.

Others are only able to feel the rhythm of the vibrations. In other cases the success of these tests has strained the emotions of the engineers who have witnessed the joy of those who find themselves perceiving sounds for the first time in years, or even in their lifetime.

Experiments will be continued to develop this phase of radio so that it may be applied in a practical manner.

Characteristics of Airplane Antennas

By E. Bellini

(Translated from the Radio-Revue of Paris)

THE antenna that is customarily employed on airplanes consists of a cable some 40 meters (132 feet) long, provided with a weight at its end. This weight can be rolled up or unrolled according to the need, or even cut in case of danger. In full flight this antenna takes the form shown in figure 1. The ground, or more properly the counterpoise, consists of the metal in the airplane, such as the motors, guy wires, etc.

This antenna is very efficient, but it presents the defect of being strongly directional both in transmission and reception. Figure 2 shows a diagram of the energy radiated in different directions by such an antenna, the airplane being at a distance of about 10 kilometers (6 miles) and at a height of about 1,600 meters (5,280 feet). The maximum energy is radiated in a direction opposite to the free end of the antenna. In the case of figure 2 the maximum energy is 54 times greater than the minimum. This figure varies according to the angle of elevation of the airplane, the length of the antenna and the speed, as well as some other factors, but the ratio is always more or less high. In consequence if the airplane flies directly away from the receiving station on the ground, the two will be able to work by radio only during a relatively limited time.

The shape of the airplane antenna varies according to the speed, but always remains strongly inclined to the vertical and never by any chance approximates a horizontal position in normal flight. One can then easily see that an airplane antenna must have characteristics that are quite individual, compared with vertical antennas, loops or other aerials installed on the surface of the earth. The situation is not less complicated by the fact that an airplane can occupy all positions in space, and may even fly over the receiving station. Tests, long and delicate, have confirmed these conclusions.

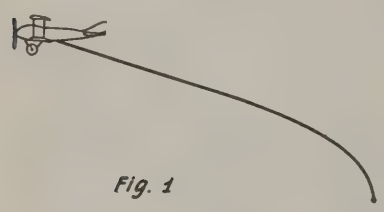


Fig. 1

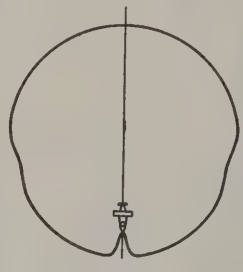


Fig. 2

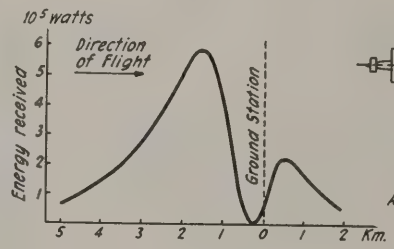


Fig. 3

Fig. 4

Fig. 7

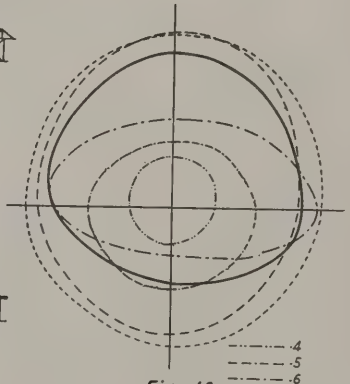


Fig. 10

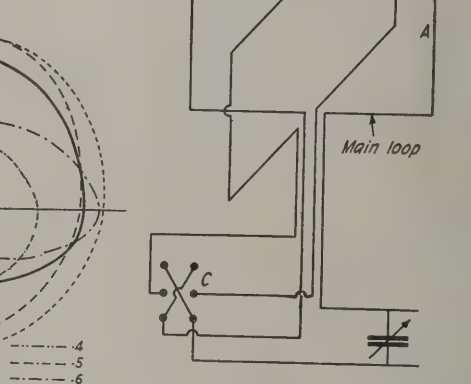


Fig. 13

Fig. 5

Fig. 8

Fig. 6

Fig. 9

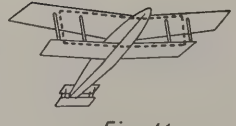


Fig. 11

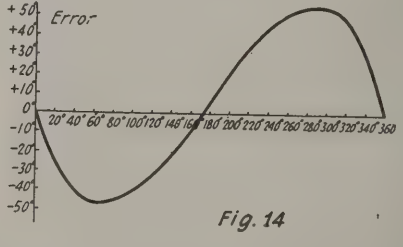


Fig. 14

Details and characteristics of antennas for airplanes

Figure 3 shows the curve of volume of reception when the airplane flies at a constant height of 1,600 meters (5,280 feet) in a vertical plane passing through the receiving antenna. The received energy increases in exact proportion with the approach of the airplane to the receiving set, attains its maximum at a distance of about 1,500 meters (4,950 feet) before reaching a vertical position over the receiver, then diminishes very rapidly and becomes practically zero at a distance of about 200 meters (660 feet) before passing over the receiver. The volume then increases anew and attains a new maximum, inferior to the first one, about 500 meters (1,650 feet) after having passed over the receiving set. The volume then diminishes uniformly. If the airplane instead of flying exactly over the station on the ground passes by at one side, the maximum and minimum become less accentuated, but the general form of the curve remains the same.

An identical phenomenon is noted when one wishes to receive in an airplane transmissions from a station on the ground. The volume of reception for any location of the airplane in space varies according to the angle that the axis of the airplane forms with that of the ground station. Extremely delicate tests made with the aid of receiving apparatus employing galvanometers installed on board of an airplane have furnished a diagram of the received energy practically identical with that of the transmitted energy of figure 2. The received energy is at its maximum in the direction opposite to the free end of the antenna. The ratio of the maximum energy to the minimum energy is the same as was shown in receiving tests in the reversed direction. In a general way, when a receiving airplane flies over a transmitter on the ground, the received energy varies according to the manner observed and charted in figure 3.

The directional qualities of an airplane antenna are not sufficiently well defined to make them of service in radio compass work, except in a very rough way. These direc-

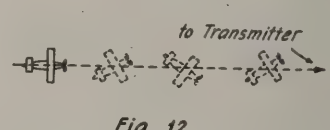


Fig. 12

tional qualities therefore, may be considered to be a detriment rather than an advantage. For that reason and for others, efforts have been made to provide airplanes with non-directional antennas. More or less success has been realized in employing antennas whose general types are indicated in figures 4 to 9. Figure 10 shows the diagrams of the energy radiated by these different types. These exceedingly interesting tests were made in Germany.

The diagram shows that these particular antennas are not at all directional, or are very slightly so. The diagram also shows, on an arbitrary scale, the relative radiated energies. The trailing antenna of figures 6, 7, 8 and 9 are 7½ meters (23¼ feet) long and bears at its extremity a weight of 500 grammes (one pound). It is easy to see that the trailing antenna loses its directional properties if it is shortened and if its counterpoise extends at right angles to it and at a sufficient distance. Unfortunately, we do not possess data upon the ranges of these antennas, compared to that of the conventional trailing antenna of figure 1, and it is feared that the range realized is much too reduced. Only additional tests can give us this information.

Radio compass work on board an airplane, and also on the ground, in order to ascertain the direction of a machine, is of the greatest importance. It permits the pilot to recover his course in mist, cloud or storm, while to the men on the ground it affords the opportunity of aiding friendly aircraft and discovering the position of enemy flyers.

Radio compass work on board an airplane can be accomplished in four different ways. First, in placing on the airplane a single loop of as large size as possible, preferably following the leading edges of the upper and lower wings, and thus being at right angles to the trailing antenna, as shown in figure 11. This system permits the pilot to ascertain the direction of a transmitter by swinging from side to side in his course, as shown in figure 12. These maneuvers, however, may become complicated, and cause the loss of time and of distance, which is generally inadmissible. The system, however, has the advantage that its receiving range is great.

Second, in placing a single small loop inside the body of the plane, the loop pivoting around a vertical axis. This permits of direction finding without changing the course of the plane. Its range, however, is limited.

Third, using the Robinson system shown in figure 13, which consists of two perpendicular loops, A and B, one within the other, one turning around a vertical axis. The windings are in series with a series-parallel switch C providing parallel connection as well. When one of the loops is directional with the transmitter, changing the series-parallel switch produces no change in the received signal. The rotatable loop, known as the "main loop," (*cadre principal*) is directed toward the transmitter. The other loop, the "auxiliary," has two or three times more turns than the first. This system avoids, somewhat, confusion caused by external sounds for instead of listening for minimum signal volume, one tunes for the maximum, and reads the position by the aid of observing the equality of the signals in the two positions of the switch. However, from the point of view of range this system is no better than that using a single loop, and may even have a lesser ability in distance work.

Fourth, using the Bellini-Tosi system with its tuned antennas, one antenna is placed longitudinally in the plane, following the axis of the craft, while the other is transverse at right angles. It is not necessary that the two have the same shape, provided that they enclose the same surface. In fact, it is the custom to give the axial aerial a slightly smaller surface than that of the transverse one, in order to compensate for the errors produced by the metallic masses of the engine and its equipment. By experiment it is possible to compensate for this error. In the three preceding installations no such compensation is possible, and a correction table or curve is necessary.

However, other factors sometimes prevent the turning loop and the Bellini-Tosi systems from revealing the exact position of an airplane. If the plane flies directly toward or from the transmitter, the position indicated by the apparatus is exact, regardless of the distance and height of the plane. This, however, is the case only when the transmitter is located at the destination of the plane, or in a line passing through the aircraft and its landing field, which is not always the case. Also, when the airplane is far distant or very low upon the horizon, that is to say when its elevation is small, the radio compass work is quite exact, independently of the course of the plane. But in all other conditions, as when the plane is not in line with the transmitter, and is relatively high above it, errors are noted. The error increases with the elevation of the plane and with its position, attaining its maximum when the plane presents its side squarely to the transmitter. An error as great as 60 degrees has been noted.

Figure 14 shows the curve of this error, taken in a particular case. In this, the scale in degrees represents the angle between the axis of the plane and that of the ground station; O corresponds to the position of the plane flying directly toward the transmitter, 90 degrees, the plane presenting its right side, etc.

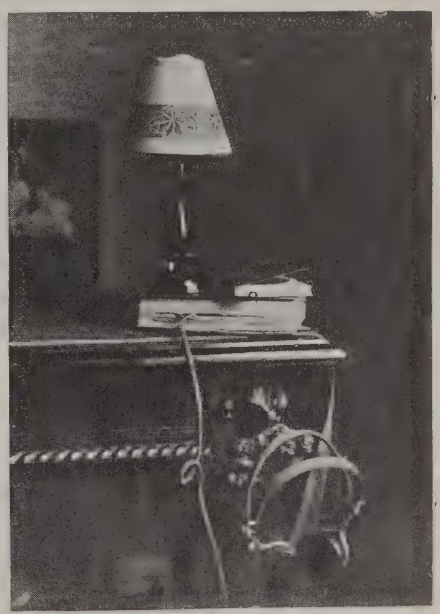
Methods have been tried for determining both the direction and the position of an airplane, but so far none of them have given positive results, and it can be said that we do not as yet possess a radiogoniometric method for locating planes. The systems we have been considering, it should be noted, have afforded only the direction of the horizontal projection of the direction of the plane, and not the actual position in the sky. However, the tests made with planes provided with antennas as shown in figures 4 to 9 have indicated results that are exact enough for practical purposes.

ALBERT C. EISELLE of Cleveland Heights, Ohio, has received 168 broadcasting stations in four countries: the United States, Canada, Cuba and Porto Rico. The following stations have been heard with two tubes:

KHJ	Los Angeles, Calif.	2,100 Miles
KGW	Portland, Oregon	2,100 Miles
KLZ	Denver, Colo.	1,250 Miles
KFAF	Denver, Colo.	1,250 Miles
KDYL	Salt Lake City, Utah	1,600 Miles
CFCN	Calgary, Alta., Canada	1,650 Miles
CJCG	Winnipeg, Man., Canada	1,000 Miles
PWX	Havana, Cuba	1,300 Miles
6KW	Tuinicu, Cuba	1,400 Miles
WCM	Austin, Texas	1,175 Miles
WFAA	Dallas, Texas	1,100 Miles
WBAP	Fort Worth, Texas	1,110 Miles
WOAI	San Antonio, Texas	1,250 Miles
WAAB	New Orleans, La.	1,000 Miles

A Home-Made Library Radio Set

THE structural details of the home-made radio telephone receiving outfit of Arthur B. Pierce of Washington, D. C., do not constitute the proverbial "open book." In reality, the apparatus, for the most part, is concealed between the covers of a book. Then, too, while the butcher, the baker, and the candlestick-maker may be interested in wireless telephony, this individual is probably the first person to utilize a candlestick as a harmonizing influence in the arrangement of wireless instruments in a library.



The home-made library radio set

Mr. Pierce calls it a "library radio set." Two books and a candlestick are the household units that serve to harmonize the radio telephone installation with the conventional equipment of a home library. One of the books, occupying a lower position on the library table, contains within its pages the four binding posts and wires essential to the operation of the wireless receiving set, with the exception of the tuning coils. The latter, of the spider-web type are concealed within the covers of a smaller book, and they are readily operated by merely opening and closing this book.

The crystal detector occupies a position at the base of the candlestick; the concealment of this sensitive mineral not being attempted, since to the casual observer it has the semblance of an electric switch. Moreover, when the candlestick is lighted, its illumination is reflected directly on the crystal.

This "library radio set" is in complete harmony with the furniture in the midst of which it is installed. The mahogany candlestick corresponds with the table and its shade with the wall-paper.

Wavelength versus Kilocycles

By Walter A. Cohen

THE Radio Conference at Washington recommended that the tuning adjustment of a broadcasting station be expressed as a frequency in kilocycles rather than as a wavelength in meters. The present texts and most articles until recently have used the wavelength terminology, so that some of the fans had difficulty in tying up meters with kilocycles. For the benefit of these, the present article is written.

The transmission of a broadcasting station is not limited to a single frequency or wavelength but for the proper transmission of speech or music, so called side band frequencies are necessary including in all, a band of about 10,000 cycles or 10 kilocycles. As the frequency varies inversely with the wavelength, the number of meters included by this 10,000 cycle band will vary with the wavelength upon which the station is operating. Thus, at 200 meters, a 5,000 cycle band either side of the fundamental would include wavelengths from 199.3 meters to 200.7, a band of only 1.4 meters, while at 600 meters, a 10,000 cycle band would include wavelengths from 594 to 606 meters, a band of 12 meters. Thus it is seen that the new method of expressing the frequency in kilocycles rather than the wavelength in meters is by far the easiest and by far the most comprehensive system to use. This is the basis of the new broadcasting schedule whereby the country is divided into districts and each station is separated in a given district from the next by at least 10,000 cycles, thus obviating interference and permitting simultaneous operation of stations.

Knowing the wavelength, it is quite easy to compute the frequency by means of the simple formula shown below:

$$n = \frac{v}{\lambda}$$

where n equals the frequency in cycles, λ the wavelength in meters and v the velocity of propagation of electromagnetic waves, 186,000 miles or 300,000,000 meters (almost) per second. Substituting in this formula for 200 meters, we arrive at the following results:

$$n = \frac{300{,}000{,}000}{200} = 1{,}500{,}000 \text{ cycles}$$

This is rather a large number to express and handle conveniently and so, for convenience, we divide v by 1,000, expressing it in kilometers instead of meters and our result n is then expressed in kilocycles, in the present case, 1,500 kilocycles, a much more convenient figure.

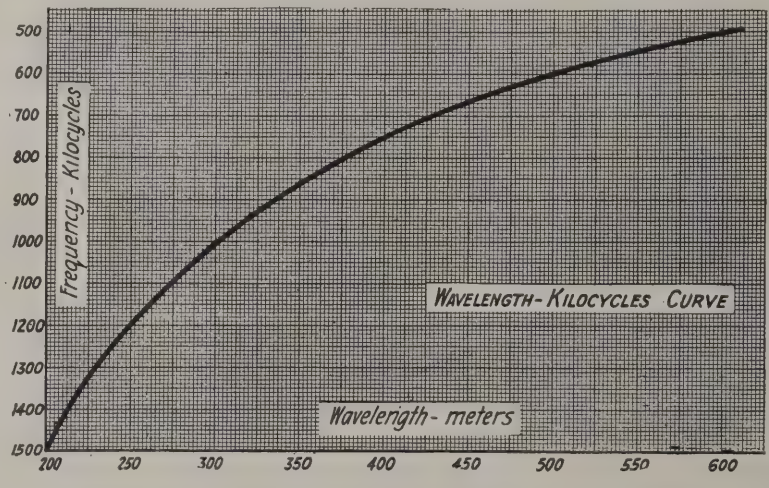
Conversely, knowing the frequency, we may obtain the wavelength by transposing the above formula and we then have:

$$\lambda = \frac{v}{n} = \frac{300{,}000}{1{,}500} = 200 \text{ meters}$$

However, to obviate the use of even this simple calculation, the appended curve will prove useful for ready reference. The ordinate or vertical column is expressed in kilocycles and the abscissae or horizontal column in meters. Thus knowing one value we may easily and quickly find the corresponding value. A practical example follows:

Suppose we wish to find the wavelength so that we may tune in a station listed in the broadcasting column of the newspapers as 833.3 kilocycles. We search in the left hand column of the curve for 833.3. Here we find 10 small divisions between each 100 kilocycles. Therefore each small division must represent 10 kilocycles. Thus we will find 833.3 three and three tenths spaces below 800. Having located this point, we follow to the right in a horizontal line until we intersect the curve. From this point we drop down perpendicularly to the bottom of the sheet where we will find the wavelength. Here, each small square represents 2½ meters, and as the point sought is four small spaces to the right of 350, the wavelength must be 350 plus 4 x 2½ or 360 meters.

Having the wavelength given, to find the number of kilocycles, we just reverse the process.



Graphic curve to determine wavelength in kilocycles or meters

My Martian Radio Signals

By Old Timer

RADIO has its perennials. Mysterious signals, presumably originating somewhere off in space, most likely on the planet Mars, constitute one of our best radio perennials. Every twelve months the mysterious Martian signals again come up for a column or two of newspaper space, a few statements from the leading scientists, a due share in everyday conversation, and the forefront of the stage of our imagination.

I happened to be working for a large radio company back in those early days. Down in the lower end of New York City, off to one side of the towering buildings of the financial district, my employers maintained a stock room and small assembly shop on the ground floor of a six-story loft building. In order that we might test radio receiving sets, we had a small four-wire antenna on the roof, with a long single-wire lead-in coming all the way down to the first floor by way of a chimney. I am free to confess that such odd moments as I could get away from less pleasant tasks, I put in testing receiving apparatus and listening to the dot-dash messages which then filled the air. There were the slow and cumbersome Continental Code messages and the light, rapid, staccato Morse Code messages. The Marconi stations and ships employed the former, while the American radio stations and ships employed the latter.

In the course of my experiments, I conceived the brilliant idea of making a super magnetic detector. That form of detector has long since passed out of existence so far as everyday radio is concerned. At any rate, lest you do not know what a magnetic detector is, I am going to explain it in a few words. The magnetic detector consists of a primary winding, connected with the antenna and ground, and a secondary winding connected with the telephone receivers. A pair of permanent magnets is arranged so that the two north poles and the two south

poles are close to the coils. Passing through the coils is a band of soft-iron wire, which moves through the coils and over two grooved pulleys by means of clockwork. The signals, flowing through the primary coil, induce a current in the secondary coil which flows through the receivers and produces audible sounds.

Now my super-magnetic detector made use of a five-kilowatt open-core transformer—a huge spark coil, in brief, since it was a Telefunken coil made just like a spark coil such as you would find in the well equipped physics laboratory. I had a simple means of agitating the soft-iron core so as to simulate the action of the moving band of iron wire of the real magnetic detector. The primary of the transformer was connected with the antenna and ground, through simple tuning apparatus, while the secondary was connected with a pair of head phones.

Much to my surprise, signals came through with thundering regularity. Sure enough, the signals were being received, but it did not require more than a few moments to decide that these were not the usual radio messages. Dashes predominated, with here and there a lonesome dot. It was more on the Continental code order, but still it was not Continental. What could it be?

Martian signals, of course! What else could it be? I called in the superintendent of the shop and he listened to the mysterious signals in perfect amazement. Then we sought one of our operators and had him listen to the mysterious signals. After ten minutes of concentration, during which he endeavored to decipher the mysterious signals, he decided that they must be signals from somewhere off in space. Here we were, face to face with an achievement which would startle the world.

Our manager, after listening to the signals for an hour or more, was convinced; but he gave instructions not to let a word of this great achievement get out until we could learn more about it.

A week went by, during which time I was assigned to the somewhat monotonous task of listening in to the Martian signals, hour by hour.

And then came the rude dénouement of the Martian signal episode. A lineman for a stock quotation ticker service came to our shop one morning and asked permission to get to our opening into the chimney. We granted his request. Pretty soon, he was hard at work pulling out several wires, which he tapped by means of those little clips provided with sharp spikes that can pierce the insulation and reach the copper conductor of any wire. He then connected a telegraph sounder with the tapped wires. To our astonishment, the sounder gave forth the very same sluggish dashes with the sprinkling of dots which we had been listening to all these weeks! The Martian signals which we had been receiving were nothing more or less than the impulses sent over the stock quotation ticker wires for operating the stock quotation tickers. Paralleling our lead-in wire, the ticker circuit wires were inducing fairly strong currents in our radio circuit. The huge induction coil served to transform the induced current into one quite suitable for the operation of the telephone receivers. Our Martian signals, therefore, were not radio signals to begin with, and they did not come from far off in space. They were quite earthbound, you may be sure.

Radio's Place in Communication Service

By Orrin E. Dunlap, Jr.

A QUESTION which has often been asked is whether or not radio will become a public utility more important than the telephone, telegraph, or cable. A glance at the history of communication as well as that of transportation shows that each new system has supplemented methods already in existence, affording and providing a greater range of facilities to meet new up-to-date conditions and to render more efficient public service.

Radio waves linked Japan with the rest of the world after seismic waves had caused catastrophe and destroyed all other means of communication. Cable relay stations were carried away, telephone exchanges swamped, inland telegraph and telephone lines destroyed and many operators killed. The earthquake spared the 660-foot tower of Japan's most powerful radio station, which answers to the call JAA. The Radio Corporation of America through its San Francisco and Honolulu stations maintained constant communication over the transpacific circuit in the ether lanes and showed how admirably radio could supplement other means of communication.

During the month of August, 1922, the Irish Irregulars took possession of seventeen cable lines linking Europe with the American continent causing accumulation of piles of messages. The great radio circuits, operated by the Radio Corporation of America, leading to England, one to Norway, one to Germany and another to France were soon handling the diverted traffic which was scheduled to travel beneath the Atlantic as cablegrams, but instead arrived in the United States at the speed of sunlight via the ether. Radio facilities, both transmitting and receiving proved adequate for the heavy traffic entrusted to it. Delays were kept down to a minimum and the Hertzian waves demonstrated their ability to supplement the cables.

When the subway and elevated lines were opened in the large cities of the country many were of the opinion that the surface cars would no longer be of use. But time has attested that the surface car is adapted for use where an elevated or subway line cannot be operated efficiently or economically. An incidental relation exists between the telephone, telegraph, cables and radio. As systems of communication each method aids the other, since their individual characteristics enable them to accomplish and overcome conditions adverse to any one method of communication. The telephone cannot reach everyone, neither can the telegraph, the cables or radio but with all four working together it is possible to reach any spot on the face of the earth by the telephone transmitter, microphone of radio or key of the telegraph. The steamship, the railroad, the airplane and automobile all supplement each other and so it will be with the telephone, telegraph, cable and radio.

The applications of commercial radio telegraphy and radio telephony is particularly adapted for mobile vehicles, such as trains and automobiles, ship to ship, and ship to shore, and between airplanes and airplanes to the ground. Radio is undoubtedly the first line of communication across large expanses of water and deserts. As a medium for the dissemination of entertainment and news radio is also of great importance.

Two of the excellent features of radio not possessed by either the telephone, telegraph or cable are its great speed of 186,000 miles a second, a velocity which carries a radiogram around the earth seven and one-half times in the twinkle of an eye; in less time than a telephone receiver can be lifted from the hook to attract the attention of the operator. The second salient feature in radio is its ability to reach instantaneously an audience numbering into the millions. Already, Lord Gainsford, Chairman of the British Broadcasting Company, has stated that on the basis of one radiophone station adequately serving the whole area within a radius of thirty miles, eight stations in the British Isles will be capable of entertaining 30,000,000 people, approximately sixty-five per cent. of the population, even though crystal sets are employed for receiving. Six stations are now operating in England.

Broadcasting of the late President Harding's speeches showed radio extremely valuable as a medium to carry a vital message from the President to the people. It will be possible for a President to address Congress and at the same time talk to thousands of Americans in every State in the Union, at the same instant his voice resounds in the Capitol in Washington.

The feasibility of trans-oceanic and transcontinental radio telephony was clearly demonstrated last January in tests conducted between New York and England. Interesting and successful experiments have been performed between ships and shore. Such tests tend to portray a picture when in the future a person on board ship will be able to talk direct to his home in San Francisco, Chicago, New Orleans or New York. These events also serve to show how radio will supplement the telephone and thus render more extensive service throughout the world.

Conditions which developed from the war

were such that the manufacture of a cable would have involved a long delay in supplying service between Los Angeles, California and Avalon, on Catalina Island. Radio provided an interconnecting link for three years. If a person in Boston or any other city in the United States wished to talk with a person in Avalon, the long distance call was made in the usual way through the Los Angeles exchange of the telephone system. The voice from Boston continued over the wires from Los Angeles to the radio station at Long Beach and from that point it leaped thirty-one and a half miles of water to the radio receiving station at Pebbly Beach, where the voice was plucked from the air and put back on the regular telephone wires which lead to Avalon, without the slightest intimation to the parties talking that radio played a part in the circuit. This celebrated "talk bridge" was discontinued during the past Summer and replaced by two submarine cables. It was a case of the ether supplementing the cables.

Although radio has encountered more obstacles in radiophone service on moving trains than it has on board ship, it is safe to say that the day will come before many years pass when an individual can successfully talk from an express train speeding between New York and Chicago, to his home in any city or town in the United States or to a friend on a vessel far out on the Atlantic or Pacific.

The best applications of commercial radio telephone are over large stretches of water; in moving vehicles; in some forms of broadcasting where it is desired to direct the same communication simultaneously to a large number of persons and in remote places where it is impractical to stretch wires for telegraph or telephone. It should be remembered that radio telephony is limited in scope by natural conditions, but the same is true of the telephone and telegraph. Each system of communication is endowed with advantages not possessed by the others, but all cooperating and working together they supplement and make possible a wider and more efficient communication system; radio with its tall steel towers silhouetted against the sky, the telephone and telegraph forming a web of copper over the land and the cable secluded in the depths of the sea.

Six Antennas and Six Transmitters for Simultaneous Operation at One Radio Station

By S. R. Winters

THE antenna system of NAA—the radio telegraph and telephone transmitting station of the United States Navy Department, located at Radio, Virginia—has no counterpart in the world. The heavy traffic, as well as the variety, handled at this point has necessitated the erection of two auxiliary masts and a third addition is being contemplated. Thus, all told, six antennas, operating in conjunction with an equal number of transmitters, may be used simultaneously at one sending station when this multiple system of transmission is completed.

The multiplicity of this antenna system may be appreciated when it is considered that the use of two antennas at any one transmitting station is the ordinary limit. The traffic imposed upon NAA has demanded the installation of a many-sided system for the radiation of electric energy. The traffic of the Signal Corps of the War Department, the dispatch of communications from the United States Navy Department, the transmission of communications for the benefit of aircraft, and a broadcasting service involving the dissemination of information from practically every department of the Federal Government, are negotiated through this 24-hour, continuously operated, wireless telegraph and telephone station.

The burdens of NAA, as heavy as they are, hardly equal the diversity of its service. From the sending of a "hog flash"—market quotations on swine—to a diagnosis of neuralgia and the broadcasting of a presidential message, the offerings emanating from Radio, Virginia, eclipse the proverbial "57" varieties. The transmission of time signals, reports on weather conditions, broadcasts on the subject of geology, labor, child welfare, education, and life-saving on our coasts, are among the diversity of themes treated by this broadcasting station. Of its programs much has been written, earning for NAA the title of "Most Serviceable Government Radio Station in the World."

This article, therefore, is primarily concerned with its unique radiating system, anticipating that amateurs will be interested in this multiple antenna system. The three original masts or towers were built in 1913, this being the first unit in the chain of high-power stations subsequently erected by the United States Navy Department. One of these original masts is 600 feet high, and the other two are 450 feet tall. They are spaced 350 feet apart, and the top of the towers were designed to withstand a load of 10,000 pounds. Contrary to recent designs of towers, which contain three legs, the first ones built at Arlington or Radio are of the three-legged type and they include about three times as much steel as the towers installed within recent years.

The two auxiliary antennas recently included in the electric radiating system of NAA are comprised of masts 200 feet high, and the sixth tower, in contemplation, will likely duplicate the features of these recent antenna installations. The 200-foot towers recently added to this many-sided antenna system were formerly in use at the Washington Barracks and were purchased by the War Department for the needs of the Signal Corps when its traffic was assigned for transmission through NAA. The joint operation of this station by the Navy Department and War Department has obviated the expense that would have been incurred by the erection and maintenance of separate stations, a procedure once contemplated.

The towers and antenna system at station NAA, located at Radio, Va.

The complete antenna system at Radio, Virginia, the only place in the United States so designated, is allotted to specific services. The five antennas are described as "main," "aircraft," "army," "navy," "radiophone," and the sixth antenna has not been classified with respect to its duties. An equal number of transmitters will be in operation, at the same time if desired. One of these transmitting units is reserved for the broadcasting of radio-telephone communications, and the other five transmitters will be used for the transmission of radio-telegraph signals.

Strangely enough, NAA, with its six-fold capacity for the radiation of messages on electro-magnetic waves, is not provided with facilities for the reception of wireless signals. Moreover, both the Office of Communications of the Navy Department and the Signal Corps of the War Department handle their traffic from different buildings by remote control systems. That is to say, the Signal Corps, for instance, sends its messages to all parts of the United States from headquarters in the Munitions Building, four miles removed from Radio, Virginia.

Similarly, the Office of Communications of the Navy Department, which intelligence division is located on the second floor of the Navy Department Building, directs its naval traffic by means of remote control with such points as Key West, New Orleans, Boston, and San Juan. The effectiveness of this multiple radiating system—six antennas and as many transmitters—is such as to embrace a large area of the United States. By means of the radio-telephone transmitting outfit, recently installed, a presidential message or the speeches of other distinguished officials in Washington may be dispersed to the middle western states and southward as far as New Orleans. Under favorable atmospheric conditions, the audible range of NAA is within a radius of 1,500 miles of the National Capital.

The three main types of equipment for radiating electric energy are employed at Radio, namely, arc, spark, and tube transmitters. Weather forecasts are dispersed at 10 o'clock in the morning and at the same hour in the evening by means of an arc transmitter, using continuous waves of 5,950 meters. Weather reports are also sent daily and Sunday by use of the radio-telephone tube transmitter. Time signals from the Naval Observatory, weather reports, ship orders, and naval press news are transmitted regularly by means of a spark transmitter, operating on a wavelength of 2,650 meters. Market reports are disseminated by both radio telegraph and telephone, and the various broadcasts from the different Government departments are dispersed by the radio-telephone tube transmitter.

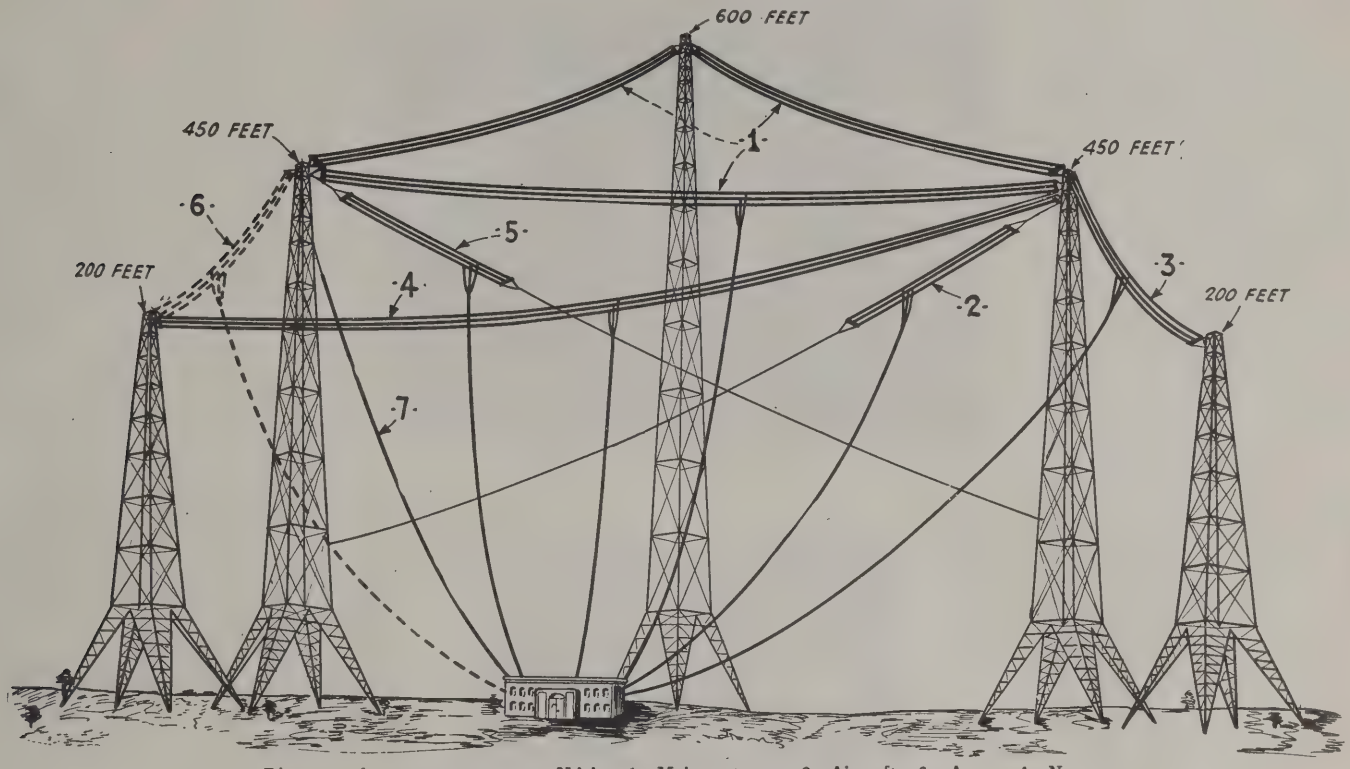


Diagram of antenna system at NAA. 1—Main antenna; 2—Aircraft; 3—Army; 4—Navy; 5—Radiophone; 6—Not classified; 7—Radiophone broadcasting

A Method of Continuous Wave Transmission on 100 Meters

(*Continued from page* 48)

The result of the second daylight-darkness tests with 8XK were as follows: The schedule was as before. During the early afternoon the signals came through rather poorly. The weather was cloudy at both ends. However, at 3:30 p. m., when the sun was shining brightly at the receiving end and it was cloudy at the transmitting end, the C. W. signals were heard with an audibility of 170. The I. C. W. was also heard. This signal strength was greater than at any time during the day of the previous tests and when it was cloudy all day.

Some fading was noted, especially at 8:15 p. m., when the usual night fading observed on the commercial wavelengths was experienced. During the evening the audibility averaged approximately 200 to 300. The I. C. W. averaged about 100. The measurements of audibilities are only approximate as considerable interference from power induction was experienced at the receiving end.

As a result of these tests it may be concluded that short-wave transmission at 105 meters, using the antenna and circuits described, is entirely practical over a distance of 300 miles. It would seem that for daylight transmission, especially, there are marked advantages in the use of such a system.

Interference from strays may also be greatly reduced since it is feasible to use a small coil antenna at the receiving end. Furthermore, strays or atmospheric disturbances are not as intense on wavelengths of 105 meters as on longer wavelengths.

While a sufficient number of tests have been made to draw the conclusions stated, the results indicate that short-wave transmission on 100 meters or still shorter wavelengths should be investigated further. It is expected that further experiments will be made and results reported to the Air Service.

Practical Demonstration of Radio Equipped Motor Repair Lorry

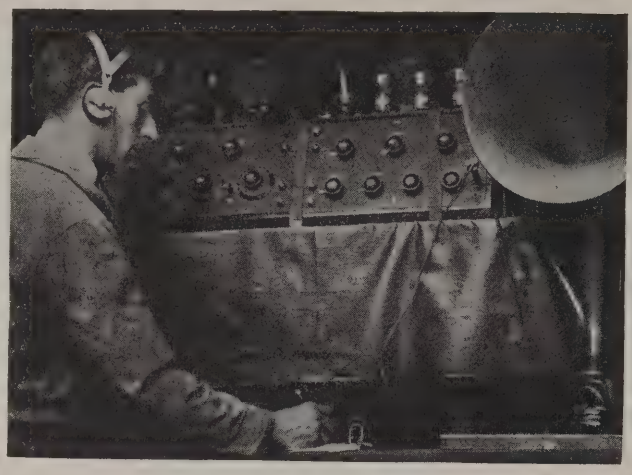
By J. S. Smith

RADIO telephony continues to present opportunities for enterprising methods of communication in unusual circumstances, and J. S. Woodhams of London, England, has utilized this method of communication in connection with a radio telephone installation between a motor repair vehicle on the open road and its headquarters.

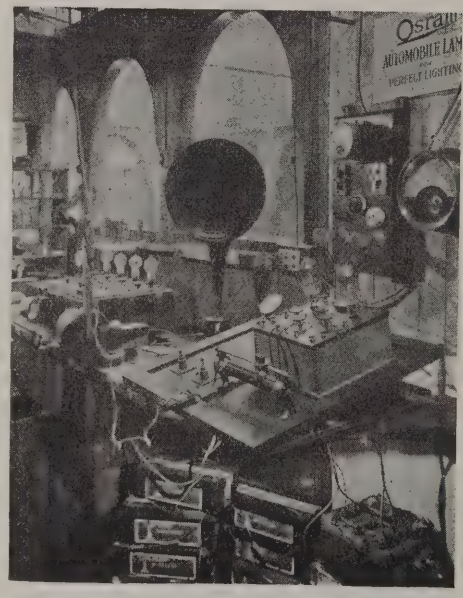
The motor repair lorry is equipped with a sensitive receiving apparatus, and the garage has its transmitting and receiving plant so that while the vehicle is away from headquarters its driver can still receive messages and instructions.

The test was arranged as follows: The repair van was sent out in answer to an imaginary summons from an owner-driver who had broken down at a pre-determined position and while the vehicle was away the garage was supposed to have received another request for assistance from a further automobile that was broken down in the vicinity of the first mishap. This is a very common situation and one where time and money can obviously be saved if a message can be received by the repair lorry in order to prevent it returning to the garage before going on the second job, thus making unnecessary the second journey.

The van left the garage and arrived at the scene of the first imaginary breakdown and the garage was requested to get in touch with the driver and instruct him to take care of the further breakdown about three miles further on. It is interesting to note that during the transmission of the radio telephonic communication it so happened that 2LO the London broadcasting station was carrying out some tests and the fact that the small power garage station was received three miles away in the van at a point only one and one-half miles from the powerful broadcasting station at 2LO furnished definite proof that notwithstanding such adverse conditions sufficient selectivity of tuning is possible to accomplish the desired results.



The receiving set in the lorry



The transmitting set at the garage

In order to avoid the necessity of maintaining a constant watch on the repair lorry an arrangement has been made whereby communication is established definitely every quarter of an hour, two synchronized watches being used for the purpose. This arrangement insures actual communication whether the van is attending a breakdown or in motion on the road. In the latter circumstances notwithstanding extraneous noises from the motion of the vehicle itself and neighboring traffic, no inconvenience in reception is experienced.

The repair lorry it should be mentioned is equipped with benches and tools so that adjustments and small repairs can be carried out on the scene of the breakdown. A crane is also fitted which is stowed away in the body when not in use and which serves to support the front end of a vehicle which has to be towed in for repairs.

The transmitting plant located at the garage near Piccadilly Circus, London, a spot familiar to American visitors, consists of a two-tube transmitter. The tubes employed are of the Marconi Osram type, one being utilized to produce the necessary power and the other being used to furnish modulation by the well known "choke control" method. The necessary high plate voltage is supplied by means of Ever-ready dry batteries in preference to the usual high voltage motor generator.

This method of obtaining a high potential is not adopted from the point of view of cost, but on account of their reliability and the fact that they require little or no attention and do not require the attention of a skilled operator. It should be mentioned at this point that the whole installation can be operated by a layman.

The dry batteries mentioned are found to

(*Continued on page* 63)

The lorry with the aerial raised

The aerial lowered, showing the adjustable aerial poles

Distortion in Audio Frequency Amplifiers

A Good Deal of Poor Quality Is Caused Through the Incorrect Use of Audio Frequency Amplifiers. This Article Deals Step by Step With Each Factor Which May Cause Distorted Signals

By S. O. Pearson, B.Sc.
(The Wireless World and Radio Review)

WHEN it is desired to amplify wireless signals or telephony sufficiently for reception on a loud speaking telephone, it is almost essential to employ one or more stages of audio frequency amplification after the rectifier. The kind of audio frequency amplifier most commonly used is the transformer-coupled type, on account of its relatively large amplification for a given number of thermionic valves. Instruments of this type must be very carefully designed if the received speech is to be free from distortion, and in this instalment the chief causes of distortion, and their effects, are discussed, suggestions being given in each case for the elimination of distortion as far as possible. For reasons given below it will be seen that the transformer-coupled audio amplifier can never be quite free from distortion, although with careful design very good results can be obtained.

It is quite commonly found that the results given by a set operating a loud speaker are not as clear as those given by a set operating head telephones only, where no audio frequency amplifier is used. For this reason it is often assumed that the loud speaker must be at fault, but this is not usually the case. The writer has found that with a carefully designed amplifier the results given by a loud speaker are even more pleasing to listen to than those of head telephones.

The chief causes of distortion in the transformer-coupled type of amplifier may be classified as follows:

(1) Operation too near either of the bends in the characteristic curve of a tube.
(2) Saturation of one or more of the tubes.
(3) Resonance effects in the transformer windings and circuits.
(4) Presence of high frequency oscillations in various parts of the circuits.
(5) Effect of the iron cored transformers.

These several causes are discussed in turn below, and, where possible, suggestions are given for their elimination.

Operation Too Near the Bends of the Characteristic Curve

This is one of the most common causes of distortion and is simply due to faulty adjustment. The vibrations which go to make up speech or music are of a very complex nature, and if oscillations of potential representing in wave form the vibrations of perfect speech are impressed on the grid of a valve, then, in order to get magnified speech without distortion on the output side of the tube, the wave-form of the oscillating component of the plate current must be an exact reproduction of that of the grid potential. This is only possible when the operating portion of the grid voltage-plate current curve is a perfect straight line. Now the valve characteristic curve is usually approximately a straight line over a limited range only, and therefore it is most important to see that the normal grid potential is adjusted to such a value that operation takes place over the straight portion of the curve. The correct grid potential is not fixed for any particular tube, but depends on the value of the plate potential. There is a separate static characteristic curve for each value of the plate potential, and a "family" of such characteristic curves is shown in figure 1 for various plate voltages and constant filament current. Varying the filament current simply has the effect of changing the positions of the upper bends of the curves without appreciably affecting the lower portions.

The simplest arrangement is obtained when such a plate voltage is employed that zero grid potential will allow the tube to functiton at or near the middle point of the straight portion of the characteristic curve,

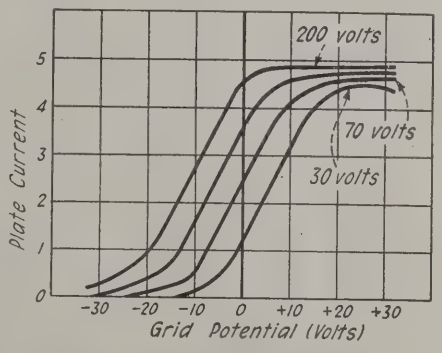


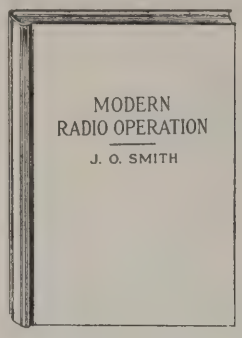
Figure 1.—A group of characteristic curves for various plate voltages and constant filament current

as in this case no grid battery is needed. This is the most usual arrangement, and the plate potentials recommended for various types of tubes by their respective makers are given on the assumptiton that the normal grid potential in each case, for purposes of amplification, is zero with respect to the negative end of the filament. Modern hard tubes which are manufactured in large quantities are fairly uniform, and in general it is quite sufficient to accept the manufacturers' figures. However, one occasionally comes across a tube with peculiar characteristics of its own, and therefore if facilities are available, it is advisable to determine the chief characteristics of all tubes in use.

The coupling between two tubes of an audio frequency amplifier constitutes an impedance connected in series with the plate of the first tube, the object being to obtain variations of potential differences across it proportional to the oscillations impressed on the grid of that tube but having been magnified. These magnified oscillations of potential are passed on to the grid of the second tube by transformer action. For satisfactory working the impedance of the inter-tube coupling at the lowest note frequency to be dealt with should be at least equal to the plate to filament resistance of the tube. An ordinary power transformer is designed to take as small a no-load current as possible without making the design too expensive, and the condititon in an inter-tube transformer are very similar; namely, that for a given amplitude of oscillating potential difference across the primary winding, the oscillating current shall be as small as possible. But in this case it is not the expense which decides the limit but the self capacity of the windings. This is discussed later.

When a very high resistance or a very high impedance is connected in the plate circuit the plate current does not vary, for a given impressed oscillation on the grid, as it would do without any impedance in the plate circuit. The anode impedance is actually placed in the circuit to prevent the current from varying, i. e., to act as a choke, and in so doing to produce an oscillating voltage across the resistance or impedance. Thus we do not get variations of plate current of the order suggested by the ordinary anode characteristic of the tube. This is due to the fact that the plate potential is no longer constant, being at every instant equal to the difference between the voltage of the B battery and the voltage across the primary of the transformer. However, the oscillations across the primary of the transformer will be a fairly exact copy of those impressed on the grid if the tube is operated on the straight portion of the ordinary D.C. characteristic using normal value of plate voltage, because the variation of plate current, for fixed grid potential, is nearly proportional to the variation of plate potential. This of course assumes that there is no distortion due to the iron of the transformer.

It is interesting to note what happens on connecting in the plate circuit a choke or transformer primary of infinitely great impedance, but whose resistance is sufficiently low to allow the D.C. component of the plate current to flow and thus maintain the average potential of the plate at the normal value. Under these conditions the plate current could contain no oscillating component at all, even though an oscillation is being impressed on the grid. But across the choke there will be an oscillating potential difference of such a value that the plate potential is varied in such a manner as to maintain the plate current constant. Under these conditions the tube gives its greatest possible amplification, and the ratio of the amplitude of the oscillation across the choke to that applied to the grid is equal to the amplification constant of the tube. These are really the ideal conditions of operation, but in practice it is impossible to wind a



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—the proper proportion of plate current when not modulating to the normal full-load current when modulating?
—how to eliminate excessive plate current when no adjustment of the circuits will do it?
—the percentage of increase in output to be expected by the addition of one or more tubes to a transmitter?
—the advantages and disadvantages of transmitting circuits employing direct current on the plates; A. C., with half-wave rectification; A. C. with full-wave rectification, kenotron-rectified A. C.; and which type of circuit is the most economical and at the same time most efficient?

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LIST OF CHAPTERS

1. The Radio Telephone.
2. Transmitting Equipment Used in Radio Telephony and Its Operation.
3. Typical High Power Broadcasting Stations.
4. Receiving Equipment for All Purposes and Its Operation.
5. Spark vs. Continuous Wave Transmission.
6. Vacuum Tube Fundamentals.
7. Operating Characteristics of Vacuum Tubes.
8. Methods of Obtaining Plate Potentials, and Types of Continuous Wave Transmitters.
9. Continuous Wave Transmission by Amateurs.
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choke or transformer with very large impedance on account of the self capacity of the windings. With an impedance, at a given frequency, equal to the internal resistance of the tube, the voltage amplification will be just half the amplification constant, but with a step-up transformer this may be multiplied by about three before being applied to the grid of the next tube.

The foregoing remarks have been added because it does not seem to be generally appreciated that the current oscillations in the plate circuit of a tube coupled to another as described above, are suppressed as far as possible, being virtually converted into voltage oscillations. Also, neglecting self-capacity, an inter tube transformer when in operation is really on no-load or open circuit, assuming that the grid of the second tube does not draw any current. Thus it will be seen that the very common statement that the impedance of the inter tube coupling must be equal to the internal impedance of the tube for best results, is rather misleading—the higher the impedance the better is the amplification. The same conditions apply as regards voltage amplification, to the transformer-coupled as to the resistance-coupled amplifier, and in figure 2 a curve is shown giving the relation between resistance or impedance in the plate circuit and the voltage amplification. With the transformer, of course, the impedance varies with the frequency, whereas for the ohmic resistance the impedance is practically constant for all frequencies.

The tube for which the curve of figure 2 was drawn had an amplification constant of about 7, its internal resistance being 27,000 ohms, and the curve shows that when the impedance in series with the plate is 27,000 ohms the voltage amplification is 3.5. Now since the impedance of a transformer varies in almost direct proportion to the frequency, it follows that the voltage amplification will be different for different frequencies, and the higher frequencies and harmonics will be amplified to a much greater extent than the lower ones. The effect of this is to give the speech a sharp piercing sound, and in the case of music the base notes are almost, if not entirely, swamped by the higher notes. This defect is usually overcome by shunting the primaries of the transformers with small condensers of the order of 0.002 mfd., so as to offer a lower impedance to the higher frequencies, these small capacities not materially affecting the impedance offered to the lower note frequencies. The effect is to give the speech or music a more mellow and pleasing tone.

Saturation of One or More of the Tubes

When the signals have been amplified up through successive stages to such an extent, and the amplitude of the oscillations applied to the grid of, say, the last tube, are so great that operation takes place right around both bends in the characteristic curve, that tube is said to be saturated. When this occurs, all the peaks of the waves are cut off or flattened out both top and bottom, and very bad distortion is the result. If the tube is only just saturated the trouble can usually be overcome by brightening the filament and using a higher plate potential on the last tube. This has the effect of considerably lengthening the straight portion of the characteristic curve. When a much higher plate voltage is employed it is usually necessary to apply a negative potential to the grid in order to work at the correct point of the new curve. When very loud results are required it becomes necessary to employ a larger tube of the type used for transmitting purposes and capable of giving out a considerable amount of power.

Resonance Effects

It was stated above that the windings of intertube transformers are never free from self capacity. This capacity and the added capacity across the primary mentioned above, in conjunction with the inductance of the windings of a transformer may constitute a tuned circuit, especially if the resistances of the windings are low. This is usually the case and should the natural frequency of resonance of the transformer lie within the range of audible frequencies received, "blasting" will take place whenever a note of that frequency occurs, this being one of the faults of cheap transformers wound with insufficient wire. It is usual to shunt the primaries of the intertube transformers for the reason given above, and this tends to bring the natural frequency down below the audible range. When a cheap transformer with too high a natural frequency is shunted by a condenser sufficiently large to bring the resonant frequency down below audibility, it is usually found that most of the higher harmonics of the speech wave pass through the condenser instead of through the transformer winding, with the result that the speech has a muffled sound. When buying an intertube transformer it always pays to get a good one.

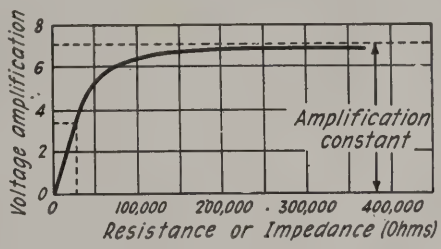


Figure 2.—Curve giving the relation between resistance or impedance in the plate circuit and the voltage amplification

Presence of Local Oscillations

Sometimes in low frequency amplifiers it is found that continuous oscillations are set up and maintained. Their frequency may lie within the audible range, in which case the set is said to "howl," a phenomenon with which most experimenters are familiar; but on the other hand the frequency of these local oscillations may be above the range of audibility, and will not be heard in the telephones when no speech is being received. Even when speech is being received the high frequency oscillations will not be actually heard, but they have a detrimental effect on the quality of the speech or music, this effect being rather difficult to explain in words. Those who have listened to speech received on an Armstrong super regenerative receiver will have some idea of the quality of the speech received. Apart from the high-pitched whistle there is a strange "edging" or "fuzziness" about the words.

Local oscillations of this nature are, of course, produced by stray coupling between the output and input sides of the amplifier and may be due to faulty laying out and spacing of the connections. The frequency of the oscillation will be at the natural frequency of some part of the circuit, and once having constructed an amplifier which exhibits these phenomena it is no easy matter to locate the trouble and eliminate it. This can only be done by trial, and the remedy usually lies in the reversing of one or more of the intertube transformer windings.

Low frequency oscillations or howling may take two forms, (a) ordinary free oscillations as above, and (b) the starting and stopping of high frequency oscillations in the detector circuit where the leaky grid-condenser method of rectification is used in conjunction with reaction. Howling is usually due to the latter cause, which is not really a fault in the audio frequency amplifier, but rather due to excessive reaction. When the set is made to oscillate a negative potential is accumulated on the grid of the detector and may reach such a high value that the oscillations cease. As soon as the grid has reached a voltage approaching the normal value again, the oscillations re-commence. This process is repeated several hundred times per second with the result that the set howls. When receiving telephony, of course, the set must never be made to oscillate, so that howling from the latter cause would be impossible.

Practical Demonstration of Radio Equipped Motor Repair Lorry

(*Continued from page* 60)

possess a long life when used for this purpose as the transmissions are necessarily brief. A further advantage is the elimination of ripple noises which are common to the use of a motor generator system. The total potential employed is about 1,000 volts and the batteries have been found to stand up very well to their work. The aerial current is carried to a single wire T aerial above the garage.

The receiving set employed on the van consists of a movable four-wire aerial mounted on top which is capable of being lowered by means of hand control by the driver when passing under bridges or trees.

The receiver incorporates four tubes, one radio frequency on the popular tuned anode system, a detector and two stages of audio frequency. The tuner itself utilizes honeycomb coils and a grid potentiometer to control oscillation.

Forty-five volts HT is required to the first and 60 volts to the other tubes. A Western Electric loud speaker is also included in the van installation.

The upkeep and operation costs of these sets is quite moderate and will be covered by the time and expense saved by the fact that the motor van can be kept constantly on the move from one job to another without returning to the garage.

It will be seen that this development opens up several possibilities, for in addition to a repair shop keeping in touch with a mobile van that is on the road it would be extremely useful if the vehicles employed by a parcel collecting and delivery agency could receive messages from headquarters while they were on the road.

BROADCASTING STATION DIRECTORY

(Revised to October 20th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co. .....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop.....Monterey, Calif.	261
KLS	Warner Brothers .....Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp, Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNJ	Roswell Public Service Co.....Roswell, N. M.	250
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	286
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros. .....San Francisco, Calif.	423
KQI	University of California.....Berkeley, Calif.	360
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreld.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co..San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co..Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop .....Honolulu, T. H.	360
KYW	Westinghouse Elec. & Mfg. Co....Chicago, Ill.	536
KZM	Preston, D. Allen.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDLY	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre .....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology..Portland, Ore.	360
KDYS	The Tribune, Inc.....Great Falls, Mont.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co....Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company .....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co....Reno, Nev.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZT	Seattle Radio Association.....Seattle, Wash.	360
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	360
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	Electric Shop .....Moscow, Idaho	360
KFAP	Standard Publishing Co.....Butte, Mont.	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFAY	W. J. Virgin Milling Co....Central Point, Ore.	360
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill .....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCB	W. K. Azbill.....San Diego, Calif.	278
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCL	Los Angeles Union Stock Yds...Los Angeles, Calif.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....LeMars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDB	Mercantile Trust Co.....San Francisco, Calif.	509
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agri. College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. E. Cutting.....Bozeman, Mont.	248
KFDP	Hawkeye Radio & Supply Co....Des Moines, Ia.	278
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbreeh & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	360
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEP	Radio Equipment Co.....Denver, Colo.	240
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Douglas, Wyo.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs..St. Louis, Mo.	360
KFFA	Dr. R. O. Shelton.....San Diego, Calif.	242
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Oregon	229
KFFP	First Baptist Church.....Moberly, Mo.	275
KFFQ	Markschoffel Motor Co...Colorado Springs, Colo.	360
KFFR	Jim Kirk .....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University...Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co....Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Mo., 138th Inf..St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGP	Cheney Radio Co.....Cheney, Kans.	229
KFGQ	Crary Hdw. Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGY	Gjelbaug's Radio Shop.....Baudette, Minn.	224
KFGZ	Emmanuel Missionary Co...Berrien Spgs., Mich.	268
KFHA	Colorado State Normal School..Gunnison, Colo.	360
KFHB	The Rialto Theatre.....Hood River, Oregon	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHI	Charles V. Dixon.....Wichita, Kans.	224
KFHJ	Fallon Co. .....Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFHY	R. S. McEwan.....Trinidad, Colo.	242
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip Laskowitz .....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co..Juneau, Alaska	226
KFIV	V. H. Broyles.....Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ, of Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories .....Seattle, Wash.	236
KFIZ	Daily Commonwealth.....Fond du Lac, Wisc.	273
KFJA	Central Power Co.....Brand Island, Nebr.	244
KFJB	Marshall Electric Co., Inc...Marshaltown, Iowa	248
KFJC	Post Intelligencer .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co...Oklahoma City, Okla.	252
KFJH	The Sugar Bowl.....Selma, Calif.	273
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJJ	Carrollten Radio Shop.....Carrollton, Mo.	236
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJQ	Valley Radio Div. of Electric Construction Co., Grand Forks, N. D.	252
KFJR	Ashley C. Dixon & Co.....Stevensville, Mont.	258
KFJU	Central Power Co.....Kearney, Nebr.	234
KFJV	T. H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Electric Co.....Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co..Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Monominee, Mich.	248
KFLE	National Educational Service.....Denver, Colo.	268
WBL	T. & H. Radio Co.....Anthony, Kansas	261
WBS	May & Co.....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBU	City of Chicago.....Chicago, Ill.	286
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCE	Findley Electric Co.....Minneapolis, Minn.	360
WCK	Stix-Baer-Fuller .....St. Louis, Mo.	360
WCM	University of Texas.....Austin, Texas	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDM	Church of the Covenant....Washington, D. C.	360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co. .....St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co. .....Houston, Tex.	360
WEW	St. Louis University .....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGF	The Register & Tribune.....Des Moines, Iowa	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co. .....New Orleans, La.	360
WGY	General Electric Co. .....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co. .....Kansas City, Mo.	411
WHD	West Virginia University..Morgantown, W. Va.	360
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre ...New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cino Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co. .....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp. of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America..Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKC	Joseph M. Zamoiski Co. .....Baltimore, Md.	360
WKY	Oklahoma Radio Shop.....Oklahoma City, Okla.	360
WLB	University of Minnesota.....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co. .....Indianapolis, Ind.	360
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMH	Precision Equipment Co.....Cincinnati, Ohio	248
WMU	Doubleday-Hill Elec. Co. .....Pittsburgh, Pa.	261
WNJ	Shotton Radio Mfg. Co. .....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic...Davenport, Iowa	484
WOI	Iowa State College .....Ames, Iowa	360
WOK	Arkansas Light & Power Co...Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co. .....Kansas City, Mo.	360
WOR	L. Bamberger Co. .....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record .....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm .....New Lebanon, Ohio	234
WPI	Electric Supply Co. .....Clearfield, Pa.	360
WQX	Walter A. Kushi .....Chicago, Ill.	360
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co. ....Hamilton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co. .....Utica, N. Y.	273
WSY	Alabama Power Co. .....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co. .....Toledo, Ohio	360
WTG	Kansas State Agr. College....Manhattan, Kans.	360
WTP	George M. McBride .....Bay City, Mich.	360
WWB	Daily News Printing Co. .....Canton, Ohio	360
WWI	Ford Motor Co. .....Dearborn, Mich.	273
WWJ	The Detroit News .....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WWZ	John Wanamaker .....New York, N. Y.	360
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal.....Chicago, Ill.	286
WAAH	Commonwealth Electric Co.....St. Paul, Minn.	360
WAAK	Gimbel Bros. .....Milwaukee, Wisc.	280
WAAM	L. R. Nelson Co. .....Newark, N. J.	263
WAAN	University of Missouri .....Columbia, Mo.	264
WAAP	Otto W. Taylor .....Wichita, Kans.	360
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co. .....Decatur, Ga.	360
WAAW	Omaha Grain Exchange .....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co. .....Emporia, Kans.	360
WABA	Lake Forest College .....Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence .....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co. ....Anderson, Ind.	229
WABD	Parker High School .....Dayton, Ohio	286
WABE	Y. M. C. A. .....Washington, D. C.	283
WABF	Mt. Vernon Register-News Co..Mt. Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co. .....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co....Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College .....Storrs, Conn.	283
WABM	F. E. Doherty .....Saginaw, Mich.	254
WABN	Waldo C. Grover .....La Crosse, Wisc.	234
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WAJV	Indian Pipe Line Corp .....Princeton, Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation .....Paterson, N. J.	244
WBAO	James Millikin University .....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Ft. Worth, Tex.	476
WBAV	Erner & Hopkins Co. .....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	246
WBAX	John H. Stenger, Jr. .....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co. .....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBC	Sterling Radio Equipment Co. ....Sterling, Ill.	229
WBBD	Barbey Battery Service .....Reading, Pa.	224
WCAD	St. Lawrence University .....Canton, N. Y.	280
WCAE	Kaufman & Baer Co. .....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co. Rodgers, Mich.	360
WCAG	Clyde R. Randall .....New Orleans, La.	268
WCAH	Entrekin Electric Co. .....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel .....Houston, Tex.	360
WCAL	St. Olaf College .....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co. .....Baltimore, Md.	360

WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co. ....San Antonio, Tex.	360
WCAS	Dunwoody Industrial Institute, Minneapolis, Minn.	246
WCAT	South Dakota School of Mines..Rapid City, S. D.	240
WCAU	Durham & Co. .....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co. .....Little Rock, Ark.	360
WCAX	University of Vermont .....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Music House, Milwaukee, Wisc.	261
WCAZ	Carthage College .....Carthage, Ill.	246
WCBA	Charles W. Haimbach .....Allentown, Pa.	280
WCBB	K. & K. Radio Supply Co. ....Greenville, Ohio	240
WCBD	Zion Radio Broadcasting Station .....Zion, Ill.	345
WDAD	Central Kansas Radio Supply..Lindsborg, Kans.	360
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star .....Kansas City, Mo.	411
WDAG	Martin J. Laurence .....Amarillo, Tex.	263
WDAH	Trinity Methodist Church .....El Paso, Texas	268
WDAI	Hughes Radio Corporation.....Syracuse, N. Y.	246
WDAK	Hartford Courant .....Hartford, Conn.	261
WDAL	Florida Times Union .....Jacksonville, Fla.	360
WDAM	Weston Electric Co.....New York, N. Y.	360
WDAO	Automotive Electric Co. .....Dallas, Tex.	360
WDAP	The Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers .....Philadelphia, Pa.	395
WDAS	Samuel W. Waite .....Worcester, Mass.	360
WDAU	Slocum & Kilburn .....New Bedford, Mass.	360
WDAX	First National Bank .....Centerville, Iowa	268
WDAY	Fargo Radio Service Co. .....Fargo, N. D.	244
WDBC	Kirk Johnson & Co., Inc. .....Lancaster, Pa.	258
WDBF	Robert G. Phillips .....Youngstown, Ohio	261
WEAA	Fallain and Lathrop .....Flint, Mich.	280
WEAB	Standard Radio Equipment Co..Fort Dodge, Ia.	360
WEAE	Virginia Polytechnic Institute...Blacksburg, Va.	360
WEAF	American Tel. & Tel.....New York, N. Y.	492
WEAG	Nichols Hineline Bassett Laboratory, Edgewood, R. I.	231
WEAH	Wichita Board of Trade .....Wichita, Kans.	244
WEAI	Cornell University .....Ithaca, N. Y.	286
WEAJ	University of South Dakota....Vermillion, S. D.	360
WEAM	North Plainfield, Borough of N. Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. .....Providence, R. I.	273
WEAO	Ohio State University .....Columbus, Ohio	360
WEAP	Mobile Radio Co., Inc. .....Mobile, Ala.	360
WEAR	Baltimore Am. & News Pub. Co., Baltimore, Md.	360
WEAS	Hecht Company .....Washington, D. C.	360
WEAU	Davidson Brothers Co. .....Sioux City, Iowa	360
WEAY	Will Horwitz, Jr. .....Houston, Tex.	360
WEAZ	Donald Redmond .....Waterloo, Iowa	360
WFAA	A. H. Belo & Co. .....Dallas, Tex.	476
WFAB	Carl C. Woese .....Syracuse, N. Y.	234
WFAF	Henry C. Spratley .....Poughkeepsie, N. Y.	273
WFAG	Radio Engineering Laboratory, Waterford, N. Y.	360
WFAH	Electrical Supply Co. .....Port Arthur, Tex.	360
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAM	Times Publishing Co.....St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co...Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo.	360
WFAT	Daily Argus Leader .....Sioux Falls, S. D.	360
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WGAC	Orpheum Radio Stores Co. .....Brooklyn, N. Y.	360
WGAD	Spanish Am. Sch. of Telegraphy, Ensonada, P. R.	360
WGAJ	W. H. Glass .....Shenandoah, Iowa	360
WGAL	Lancaster Elec. Supply & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd .....Pensacola, Fla.	360
WGAQ	W. G. Patterson .....Shreveport, La.	360
WGAR	Southern American .....Fort Smith, Ga.	360
WGAU	Marcus G. Limb .....Wooster, Ohio	226
WGAW	Ernest C. Albright .....Altoona, Pa.	261
WGAX	Radio Electric Co., Washington Courthouse, Ohio	360
WGAY	North Western Radio Co.....Madison, Wisc.	360
WGAZ	South Bend Tribune .....South Bend, Ind.	360
WHAA	State University of Iowa.....Iowa City, Iowa	283
WHAB	Clark W. Thompson .....Galveston, Tex.	360
WHAC	Cole Brothers Elec. Co. .....Waterloo, Iowa	360
WHAD	Marquette University .....Milwaukee, Wisc.	360
WHAG	University of Cincinnati .....Cincinnati, Ohio	222
WHAH	J. T. Griffin .....Joplin, Mo.	360
WHAK	Roberts Hardware Co....Clarksburg, West Va.	258
WHAL	Lansing Capital News .....Lansing, Mich.	248
WHAM	School of Music, Rochester Univ., Rochester, N. Y.	360
WHAO	F. A. Hill .....Savannah, Ga.	360
WHAP	Dewey L. Otta .....Decatur, Ill.	360
WHAQ	Semmes Motor Co. .....Washington, D. C.	242
WHAR	Paramount Radio and Elec. Co., Atlantic City, N. J.	231
WHAS	Courier Journal & Times .....Louisville, Ky.	400
WHAV	Wilmington Elec. & Supply Co., Wilmington, Del.	360
WHAX	Huntington Press .....Huntington, Ind.	360
WHAZ	Rensselaer Polytechnic Institute.....Troy, N. Y.	380
WIAB	Joslyn Automobile Co. .....Rochford, Ill.	360
WIAD	Ocean City Yacht Club .....Ocean City, N. J.	254
WIAF	Gustav A. De Cortin .....New Orleans, La.	234
WIAH	Continental Radio Mfg. Co.....Newton, Ia.	360
WIAI	Heers Stores Co. .....Springfield, Mo.	252
WIAK	Journal Stockman Co. .....Omaha, Nebr.	278
WIAR	J. A. Rudy & Sons .....Paducah, Ky.	360
WIAQ	Chronicle Publishing Co. .....Marion, Ind.	226
WIAS	Burlington Hawkeye-Home Elec. Co., Burlington, Ia.	360
WIAT	Leon T. Noel .....Tarkio, Mo.	360
WIAU	American Sec. & Sav. Bank.....Le Mars, Ia.	360
WIAV	New York Radio Laboratories, Binghamton, N. Y.	360
WIAW	Saginaw Radio & Elec. Co.....Saginaw, Mich.	360
WIAY	Fox River Valley Radio Supply Co., Neenah, Wisc.	224
WJAD	Jackson's Radio Eng. Lab. .....Waco, Tex.	360
WJAF	Press Pub. Co. .....Muncie, Ind.	360
WJAG	Huse Publishing Co. .....Norfolk, Nebr.	360
WJAJ	Y. M. C. A. .....Dayton, Ohio	360
WJAK	Rev. C. L. White .....Greentown, Ind.	254
WJAM	D. C. Perham .....Cedar Rapids, Iowa	268
WJAN	Peoria Star Co. .....Peoria, Ill.	280
WJAR	The Outlet Co. .....Providence, R. I.	360
WJAS	Capper Publications .....Topeka, Kans.	360
WJAT	Kelley-Vawter Jewelry Co. .....Marshall, Mo.	360
WJAX	Union Trust Co. .....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory .....Chicago, Ill.	448
WKAA	H. F. Paar .....Cedar Rapids, Iowa	268
WKAD	Charles Looff.....East Providence, R. I.	240
WKAF	W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.	360
WKAN	Alabama Radio Mfg. Co. .....Montgomery, Ala.	360
WKAP	Dutee Wilcox Flint .....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College.....East Lansing, Mich.	280
WKAS	L. E. Lines Music Co. .....Springfield, Mo.	360
WKAV	Laconia Radio Club .....Laconia, N. H.	360
WKAW	United Battery Service Co., Montgomery, Ala.	226
WKAX	W. A. Macfarlane .....Bridgeport, Conn.	231
WKAY	Brenau College .....Gainesville, Ga.	280
WLAC	North Carolina State College...Raleigh, N. C.	360
WLAG	Cutting & Washington Radio Corp., Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co. .....Waco, Tex.	360
WLAK	Vermont Farm Mach. Co.....Bellows Falls, Vt.	360
WLAL	Tulsa Radio Co. .....Tulsa, Okla.	360
WLAN	Putnam Hardware Co. .....Houlton, Me.	283
WLAP	W. V. Jordon .....Louisville, Ky.	360
WLAQ	A. E. Schilling .....Kalamazoo, Mich.	360
WLAS	Central Radio Supply Co. ....Hutchinson, Kans.	244
WLAT	Radio and Specialty Co. .....Burlington, Iowa	360
WLAV	Electric Shop, Inc.....Pensacola, Fla.	254
WLAW	New York Police Dept. .....New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station, Greencastle, Ind.	231
WMAB	Radio Supply Co. .....Oklahoma City, Okla.	360
WMAC	J. Edward Page .....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co. .....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co. .....Kansas City, Mo.	275
WMAK	Norton Laboratories .....Lockport, N. Y.	360
WMAL	Trenton Hdw. Co. .....Trenton, N. J.	250
WMAM	Beaumont Radio Equipment Co...Beaumont, Tex.	360
WMAN	First Baptist Church .....Columbus, Ohio	286
WMAP	Utility Battery Service, Inc.....Easton, Ohio	246
WMAQ	Chicago Daily News .....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAW	Wahpeton Elec. Co. .....Wahpeton, N. D.	360
WMAY	Kingshighway Presby. Church ...St. Louis, Mo.	280
WMAZ	Mercer University .....Macon, Ga.	268
WNAB	Park City Daily News....Bowling Green, Ky.	360
WNAC	Shepard Stores .....Boston, Mass.	278
WNAD	Oklahoma Radio Eng. Co. .....Norman, Okla.	360
WNAL	R. J. Rockwell .....Omaha, Nebr.	242
WNAM	Ideal Apparatus Co. .....Lima, Ohio	266
WNAN	Syracuse Radio Telephone Co...Syracuse, N. Y.	286
WNAP	Wittenberg College .....Springfield, Ohio	360
WNAQ	Charleston Radio Elec. Co.....Charleston, S. C.	360
WNAR	Rhodes, C. C. .....Butler, Mo.	231
WNAS	Texas Radio Corporation and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Bros. Co. .....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Tel. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzmann .....Fortress Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.....Yankton, S. D.	244
WNAY	Ship Owners' Radio Service .....Baltimore, Md.	360
WOAA	Dr. Walter Hardy .....Ardmore, Okla.	360
WOAB	Valley Radio .....Grand Forks, N. D.	280
WOAC	Maus Radio Co. .....Lima, Ohio	266
WOAD	Friday Battery & Elec. Co.....Sigourney, Iowa	360
WOAE	Midland College .....Fremont, Nebr.	360
WOAF	Tyler Commercial College .....Tyler, Tex.	360
WOAG	Apollo Theatre .....Belvidere, Ill.	224
WOAH	Palmetto Radio Corp .....Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Texas	385
WOAJ	Ervin's Electrical Co. .....Parsons, Kans.	360
WOAK	Collins Hardware Co. .....Frankfort, Ky.	240
WOAL	Wm. Evans Woods .....Webster Groves, Mo.	286
WOAN	James D. Vaughan .....Lawrenceburg, Tenn.	360
WOAP	Kalamazoo College .....Kalamazoo, Mich.	360
WOAR	Henry P. Lundskow .....Kenosha, Wisc.	360
WOAT	Boyd Martell Hamp .....Wilmington, Del.	360
WOAV	Pennsylvania National Guard .....Erie, Pa.	242
WOAW	Woodmen of the World .....Omaha, Nebr.	526
WOAX	Frankiyn J. Wolff .....Trenton, N. J.	240
WOAZ	Penick Hughes Co. .....Stanford, Tex.	360
WPAB	Pennsylvania State College ...State College, Pa.	360
WPAC	Donaldson Radio Co. .....Okmulgee, Okla.	360
WPAD	Wieboldt & Co. .....Chicago, Ill.	360
WPAG	Central Radio Co., Inc. .....Independence, Mo.	360
WPAH	Wisconsin Dept. of Markets ....Waupaca, Wisc.	360
WPAJ	Doolittle Radio Corporation..New Haven, Conn.	268
WPAK	No. Dakota Agricultural College...Fargo, N. D.	360
WPAL	Superior Radio & Telephone Co., Columbus, Ohio	286
WPAM	Awerbach & Guettel .....Topeka, Kans.	360
WPAP	Theodore D. Phillips .....Winchester, Ky.	360
WPAQ	General Sales & Eng. Co .....Frostburg, Md.	360
WPAR	R. A. Ward .....Beloit, Kans.	360
WPAS	J. & M. Electric Co. .....Amsterdam, N. Y.	360
WPAT	St. Patrick's Cathedral .....El Paso, Tex.	360
WPAU	Concordia College .....Moorhead, Minn.	360
WPAY	Bangor Radio Laboratory .....Bangor, Me.	360
WPAZ	John R. Koch .....Charleston, West Va.	273
WQAA	Horace A. Beale, Jr. .....Parkersburg, W. Va.	360
WQAB	Southwest Missouri State Teachers College, Springfield, Mo.	236
WQAC	E. B. Gish .....Amarillo, Tex.	360
WQAD	Whitehall Electric Co. .....Waterbury, Conn.	242
WQAE	Moore Radio News Station .....Springfield, Vt.	275
WQAF	Sandusky Register .....Sandusky, Ohio	240
WQAH	Brock Anderson Elec. Eng. Co., Lexington, Ky.	254
WQAK	Appel-Higiey Electric Co. .....Dubuque, Iowa	360
WQAL	Coie County Tel. & Tel. Co.....Mattoon, Ill.	258
WQAM	Electrical Equipment Co. .....Miami, Fla.	360
WQAN	Scranton Times .....Scranton, Pa.	360
WQAO	Calvary Baptist Church .....New York, N. Y.	360
WQAQ	West Texas Radio Co. .....Abilene, Tex.	360
WQAS	Prince Walter Co. .....Lowell, Mass.	266
WQAT	Radio Equipment Corporation.....Richmond, Va.	360
WQAV	Huntington and Guerry, Inc. ...Greenville, S. C.	258
WQAW	Catholic University of America, Washington, D. C.	236
WQAX	Radio Equipment Co. .....Peoria, Ill.	360
WQAZ	Greensboro Daily News .....Greensboro, N. C.	360
WRAA	Rice Institute .....Houston, Tex.	360
WRAD	Taylor Radio Shop .....Marion, Kans.	248
WRAF	Radio Club, Inc .....Laporte, Ind.	224
WRAH	Stanley N. Reed.....Providence, R. I.	231
WRAL	Northern States Power Co..St. Croix Falls, Wisc.	248
WRAN	Black-Hawk Electric Co.....Waterloo, Iowa	236
WRAO	Radio Service Co. .....St. Louis, Mo.	360
WRAP	Winter Park Elec. Construction Co., Winter Park, Fla.	360
WRAS	Radio Supply Co. .....McLeansboro, Ill.	360
WRAU	Amarillo Daily News .....Amarillo, Tex.	360
WRAV	Antioch College .....Yellow Springs, Ohio	360
WRAW	Horace D. Good .....Reading, Pa.	238
WRAX	Flexon's Garage .....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation .....Scranton, Pa.	280
WRAZ	Rensselaer Polytechnic Institute ...Troy, N. Y.	380
WSAA	B. S. Sprague Elec. Co. .....Marietta, Ohio	360
WSAB	Southeast Mo. State College, Cape Girardeau, Mo.	360
WSAC	Clemson Agri. College....Clemson College, S. C.	360
WSAD	J. A. Foster Co. .....Providence, R. I.	261
WSAH	A. G. Leonard, Jr.....Chicago, Ill.	248
WSAI	U. S. Playing Card Co.....Cincinnati, Ohio	309
WSAJ	Grove City College .....Grove City, Pa.	360
WSAK	Daily News .....Middleport, Ohio	258
WSAL	Franklin Electrical Co. .....Brookville, Ind.	246
WSAN	Allentown Radio Club .....Allentown, Pa.	229
WSAP	Seventh Day Adventist Church..New York, N. Y.	263
WSAR	Doughty & Welch Elec. Co. ...Fall River, Mass.	254
WSAT	Plainview Elec. Co. .....Plainview, Tex.	268
WSAU	Camp Marienfield .....Chesham, N. H.	229
WSAW	Curtice & McElwee .....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory .....Chicago, Ill.	268
WTAB	Fall River Daily Herald.....Fall River, Mass.	248
WTAC	Penn Traffic Co. .....Johnstown, Pa.	360
WTAD	Robert E. Compton .....Carthage, Ill.	229
WTAG	Kern Music Co. .....Providence, R. I.	258
WTAH	Carmen Ferro .....Belvidere, Ill.	236
WTAJ	The Radio Shop .....Portland, Me.	236
WTAL	Toledo Radio and Electrical Co., Toledo, Ohio	252
WTAM	Willard Storage Battery Co.....Cleveland, Ohio	390
WTAN	Orndorff Radio Shop .....Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	390
WTAQ	S. H. Van Gorden & Son.....Osseio, Wisc.	226
WTAR	Reliance Electric Co.....Norfolk, Va.	226
WTAS	Charles E. Erbstein .....Elgin, Ill.	275
WTAT	Edison Elect. Ill. Co.....Boston, Mass.	244
WTAU	Ruegy Battery & Elec. Co....Tecumseh, Nebr.	360
WTAW	Agricultural and Mech. College, College Station, Tex.	254
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill.	226
WWAC	Sanger Brothers .....Waco, Tex.	360
WWAD	Wright & Wright, Inc. .....Philadelphia, Pa.	369
WWAH	General Supply Co. .....Lincoln, Nebr.	360
WWAX	Worman Brothers .....Laredo, Tex.	360

Canadian Broadcasting Stations

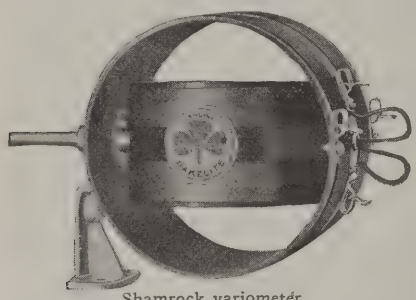
CKY	Manitoba Telephone System .....Winnipeg, Manitoba	
CFAC	Radio Corporation of Calgary, Ltd ..Calgary, Alberta	
CFCA	Star Publishing and Printing Co., Toronto, Ontario	
CFCB	Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.	
CFCD	Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba	
CFCE	Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia	
CFCF	Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec	
CFCH	Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario	
CFCI	Motor Products Corporation.....Walkerville, Ontario	
CFCN	W. W. Grant Radio, Ltd. .....Calgary, Alberta	
CFCX	The London Advertiser .....London, Ontario	
CFPC	International Radio Development Co., Fort Frances, Ontario	
CFTC	The Bell Telephone Co. of Canada....Toronto, Ontario	
CFUC	University of Montreal .....Montreal, Quebec	
CFVC	Roy Russell Brown.....Courtenay, British Columbia	
CFYC	Victor Wentworth Odium.....Vancouver, B. C.	
CFZC	Canadian Westinghouse Co., Ltd....Montreal, Quebec	
CHAC	Radio Engineers, Ltd.....Halifax, Nova Scotia	
CHBC	The Albertan Publishing Co. .....Calgary, Alberta	
CHCA	Radio Corporation of Vancouver, Ltd., Vancouver, B. C.	
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario	
CHCC	Canadian Westinghouse Co., Ltd., Edmonton, Alberta	
CHCF	Radio Coroporation of Winnipeg, Ltd., Winnipeg, Manitoba	
CHCQ	The Western Radio Co., Ltd.....Calgary, Alberta	
CHCS	London Radio Shoppe .....London, Ontario	
CHCX	B. L. Silver .....Montreal, Quebec	
CHCZ	The Globe Printing Co. .....Toronto, Ontario	
CHFC	John Millen & Sons, Ltd. .....Toronto, Ontario	
CHIC	Canadian Westinghouse Co., Ltd....Hamilton, Ontario	
CHOC	Canadian Westinghouse Co., Ltd....Vancouver, B. C.	
CHVC	Metropolitan Motors, Ltd. .....Toronto, Ontario	
CHXC	J. R. Booth, Jr. .....Ottawa, Ontario	
CHYC	Northern Electric Co. .....Montreal, Quebec	
CJBC	Dupuis Freres .....Montreal, Quebec	
CJCA	The Edmonton Journal, Ltd. .....Edmonton, Alberta	
CJCB	James Gordon Bennett .....Nelson, British Columbia	
CJCD	T. Eaton Co., Ltd. .....Toronto, Ontario	
CJCE	Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.	
CJCF	News Record, Ltd. .....Kitchener, Ontario	
CJCG	Manitoba Free Press Co., Ltd....Winnipeg, Manitoba	
CJCH	The United Farmers of Ontario .....Toronto, Ontario	
CJCI	McLean, Holt & Co., Ltd....St. John, New Brunswick	
CJCN	Simons Agnew & Co. .....Toronto, Ontario	
CJCS	Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia	
CJCY	Edmund Taylor .....Calgary, Alberta	
CJGC	London Free Press Printing Co., Ltd., London, Ontario	
CJNC	Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba	
CJSC	The Evening Telegram .....Toronto, Ontario	
CKAC	La Presse Publishing Co. .....Montreal, Quebec	
CKCB	T. Eaton Co., Ltd. .....Winnipeg, Manitoba	
CKCD	Vancouver Daily Province .....Vancouver, B. C.	
CKCE	Canadian Independent Telephone Co., Ltd., Toronto, Ontario	
CKCK	Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan	
CKCR	Jones Electric Radio Co.....St. John, New Brunswick	
CKCS	The Bell Telephone Co. of Canada...Montreal, Quebec	
CKCZ	Canadian Westinghouse Co., Ltd.....Toronto, Ontario	
CKKC	Radio Equipment and Supply Co....Toronto, Ontario	
CKOC	The Wentworth Radio Supply Co...Hamilton, Ontario	
CKQC	Radio Supply Co. of London.....London, Ontario	
CKZC	Salton Radio Engineering Co.....Winnipeg, Manitoba	

NEW APPLIANCES AND DEVICES

New Shamrock Variometer

THE Shamrock Mfg. Co. has put on the market a new variometer which has some new and improved features in variometer design.

A feature of the Shamrock variometer is the pig tail connections from the rotor to stator coil. This feature has been adopted to secure a connection that would eliminate noises and leakage.



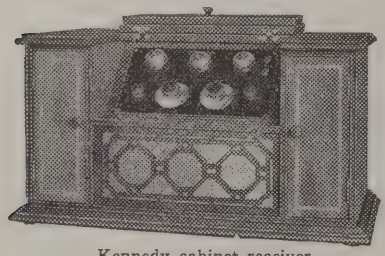
Shamrock variometer

Both rotor and stator leads have separate Fahnestock connections, permitting the use of the Shamrock as a straight variometer or a split variometer.

The floating stop arrangement employed in the Shamrock, insures a full 360° turn of the rotor within the stator, thus giving the maximum inductive efficiency. This variometer will tune up to 600 meters, which takes in all the new high broadcasting wavelengths.

Colin B. Kennedy Cabinet Receivers

THE Colin B. Kennedy Corporation has recently placed on the market a new line of cabinet receivers, known as the Kennedy Type 410 receiving units. These instruments are in mahogany with gold plated

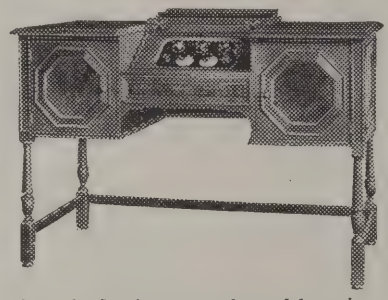


Kennedy cabinet receiver

dials and fittings, and are entirely self contained. Complete control of this new unit is accomplished by means of only two dials, one for tuning and the other for volume. The entire broadcasting range of wavelengths is covered.

These receivers may be used with any standard type of vacuum tube, dry cell batteries being contained in the cabinet and binding posts are provided on the rear for external six-volt battery connection if desired.

The new Kennedy loud speaker is also incorporated in each of these instruments. It has an adjustment for altering the tone chamber to suit the variety of broadcast being received.

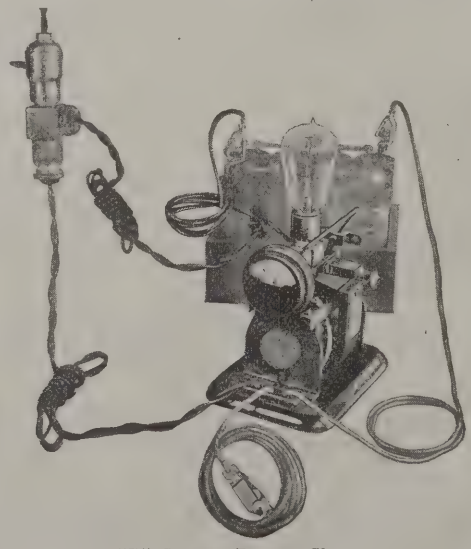


Kennedy Jacobean console model receiver

France F-F. Charging Attachment

THE France Manufacturing Company has put on the market the F-F Charging Attachment for "B" Storage Batteries, 24 to 96 Volts.

The attachment converts any F-F Battery Charger into an instrument that will charge any "B" Storage Battery of from 24 to 96 volts. The charging rate is varied by use of different sizes of ordinary lamps in accordance with instructions.



"B" Storage Battery Charger

No "A" battery is needed to make the F-F battery charger and attachment function. No changing of connections or alterations on the charger are required. There is nothing complicated about the attachment and it is claimed it will not get out of order.

Cutler-Hammer Filament Switch

THE Cutler-Hammer Mfg. Co. has placed on the market a new type of switch to control the filament current supply of receiving tubes. This new switch has been designed for use with tubes the filaments of which operate at low temperature. The switch has easily visible "on" and "off" positions. It has positive wiping contacts that

Filament switch

assure full battery voltage and cannot loosen and cause troublesome noises. The unit can be readily mounted on a panel by boring a single hole 13/16 inch in diameter.

Mesco Loud Speaker

THE loud speaker with the concert modulator is the description given to the new Manhattan loud speaker, made by

Mesco loud speaker

the Manhattan Electrical Supply Co., Inc. By means of this concert modulator, the instrument can be accommodated to all conditions and to every circuit, tube or battery with which it may be operated. No batteries are required for its use. The diaphragm is positively locked in the extra heavy lead-compound reproducing unit, precluding all vibration except in the diaphragm itself.

Brandes "Table-Talker"

FOR a long time, C. Brandes, Inc., have made only their Matched Tone Headsets, but they now announce a new piece of radio apparatus trademarked "Brandes Table-Talker," which is a loud speaker at a very reasonable price.

The new Brandes Table-Talker is finished in a beautiful neutral shade of deep brown with a crystalline finished horn and copper oxidized finish base. It harmonizes with the home furnishings. The base is felt-padded to protect polished furniture.

The reproducing unit is substantially along the lines of design of the Brandes Superior headset unit which has proved its correctness of design with certain changes which increase the volume of sound obtained.

Brandes Table-Talker is pleasing in lines and finish and superior in quality of tone and in volume.

New Feature in Phone Construction

THE Penberthy Injector Co. has recently developed a four-pole 4000-ohm double head set phone.

The windings of the four-pole phones are of the spool type. This feature with the

"Empire" fabric insulation in the bottom of the case makes grounding of the case or coils impossible; the result is that this type of phone will withstand a higher voltage without breaking down.

The permanent magnet is of the so-called consequent pole type, which are built up of two laminations.

The magnet steel is of the best quality to produce a strong magnetic field and retain its strength indefinitely. Each piece is thoroughly tested by means of a permeameter.

The final test for tone or audibility is made against a master phone and in this way each set is correctly matched at a frequency of 800 cycles.

The Penberthy (four pole) 4000 ohms head phones embody all these features in a unique design that has the following advantages:

1—Especially sensitive to weak signals.

2—True tonal reproduction under varying conditions.

3—Tube noises and strays almost entirely eliminated.

4—Stands highest amplification without distortion of sound while operating at highest efficiency.

5—High tension insulation between case and windings insures safety to operator.

Willard Introduces New Radio Battery

ONE of the latest and most progressive developments in the radio field is the introduction of a new single cell radio battery, by the Willard Company.

It is a rechargeable storage cell which possesses several new and unique features not hitherto claimed for storage batteries for radio use.

For "A" battery use on receiving sets using peanut tubes it appears in units of one cell just as dry cell batteries are used. For "B" battery use it is assembled in trays of high voltage combinations.

In assemblies of ten or twenty cell combinations, it makes a "B" battery that can be depended upon. In addition to the advantages that have long been acknowledged for storage batteries in radio, this cell is small, easily recharged at home and inexpensive.

The container is a cylindrical jar of colorless, annealed glass, practically unbreakable. Its screwed-on cover is of hard rubber with a gasket which makes the cell water tight. There are three plates in the cell, one thick positive and two thinner negatives. They are separated and insulated with threaded rubber insulation.

They require only filling with electrolyte to be ready for actual use on the radio set. Thus the purchaser loses not one moment of possible useful life.

A New Loud Speaker

THE Mu-Rad Laboratories, Asbury Park, N. J., manufacturers of radio receivers and radio frequency transformers have recently announced a new product, a loud-speaker of entirely radical design—the Mu-Rad Audiophone. Their claim is that this radio reproducer is the mechanical and electrical application of the principles of voice production to amplification. The sound producing elements resemble the human larynx in that a mica diaphragm is caused to vibrate by an "exhaling", movement of an armature stylus bar, just as the vocal cords are controlled by the larynx. All previous types of loud speakers operated on an "inhaling" instead of the normal "exhaling" principle.

The Mu-Rad Audiophone is said to reproduce extremely true to life. The normal voice ranges between 300 to 1,800 alternations per second and most music from 60 to 5,000 cycles per second. The extreme frequencies produce timbre or roundness of tone. The Mu-Rad Audiophone converts electrical impulse waves into sound waves from about 40 cycles to 7,000 cycles per second. Hence no broadcasted program is beyond the capacity of this new type of radio reproducer to revive with absolute fidelity even the most delicate overtones.

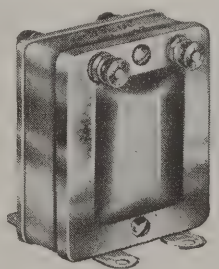
Blast and distortion are provided against by a ready adjustment of the stylus bar with a thumb screw attachment on the exterior. It also permits exact regulation of the strength of the reproduction. Weaker signals can be strengthened and louder ones toned down in a moment.

No additional battery, transformer or induction coil is necessary for the Mu-Rad Audiophone.

This reproducer represents an innovation in the designing of loud speakers.

New National Audio Transformers

THE National Transformer Mfg. Co. has developed a transformer that is designed to operate equally well on one, two or three



stages of audio-frequency amplification. The new transformers are of the shell type, with a laminated core of high grade silicon steel and are said to have a low distributed capacity. They are completely enclosed in metal cases, tending to eliminate any stray magnetic fields and noises produced by interaction between the circuits. These transformers are fitted with extra long binding posts plainly marked to insure easy connections and are furnished complete with screws for mounting and instructions for installing.

INDUSTRIAL INKLINGS

National Radio Week

WITH the hearty co-operation of the broadcasting stations, National Radio Week, which has been set for November 25 to December 1, will be the biggest event in the history of the radio business.

The basic idea back of National Radio Week is to present the very best of radio in the very best possible manner to the largest possible number of non-radio set owners.

To bring about this very desirable end, special programmes will be broadcast from every broadcasting station in the country, programmes will attempt to show the wonderful possibilities of radio broadcasting.

The Radio Week National Committee, which is working under the guidance of the Radio Trade Association, has planned the following programme:

Sunday, November 25. National Radio Sunday, at which time the attention of the public will be called to the wonderful church services broadcast, and the use of radio sets for shut-ins advocated. Every station will be asked to feature their religious programme on this day.

Monday, Nov. 26. Radio and the Stage. Showing what radio has done for the amusement world — programmes featuring popular performers and calling attention to what radio has done for plays and music.

Tuesday, Nov. 27. Government Day. The possibilities of radio as a factor in government has never been properly realized. Prominent National, State and City government officials will be asked to address the radio audience. Tuesday afternoon will be devoted to the children.

Wednesday, Nov. 28. Radio and Music.

Thursday, Nov. 29. Thanksgiving Day. Sports Day. Thanksgiving Day football games will be broadcast from many stations.

Friday, Nov. 30. Education Day, with perhaps some special feature in the line of orchestra music, especially for the smaller station.

Saturday, Dec. 1. Radio in the Home, Radio for Pleasure. Programmes especially designed as the basis for home radio parties, and the rendering of dance music.

The programme committee seems to have covered practically every feature of radio programme activity, and it is believed that stations that follow this suggested programme will benefit greatly from the advance publicity which Radio Week will receive.

The committee that drew up this programme consisted of the following: Charles B. Popenoe, director of Radio Broadcast Central, Radio Corporation of America, chairman; C. B. Cooper, vice-president of the Radio Trade Association in charge of the broadcasting committee; Bernard Freedman, news editor; E. R. Doyle, of the Allan D. Cardwell Company, Brooklyn, N. Y., and H. G. Cisin, Dictograph Products Corp., New York City.

Broadcast Station Directors who desire more information in regard to National Radio Week programmes are invited to communicate with the secretary of The Radio Trade Association, 1133 Broadway, New York City.

Coming Radio Shows

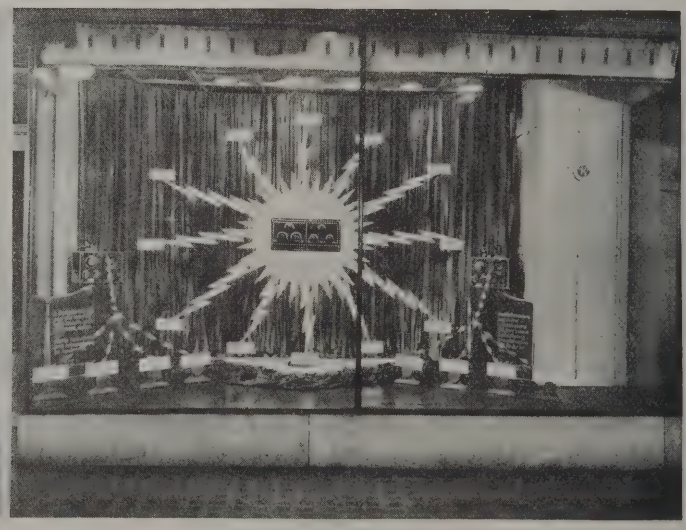
THE second annual Philadelphia Radio Show will be held at the Arena (formerly the Ice Palace), Forty-fifth and Market Streets, Philadelphia, November 12 to 17, inclusive.

E. B. MALLORY, manager of the Westinghouse Electric & Manufacturing Company's radio sales department, who is located in New York City, acted as the chairman of the Radio Communication Committee of the American Marine Congress held in New York City, November 5-10, in connection with the American Marine Exposition.

Mr. Mallory is also chairman of the radio section of the Associated Manufacturers of Electrical Apparatus.

Radio Displays That Reach the Public

A worth-while wireless window display by the St. Paul Electric Co. of St. Paul, Minn.



A three-circuit electric flash display by The National Electric Supply Co. of Washington, D. C.

Applause Cards

ONE of the hits of the Radio Show held in New York during the week of October 6th to 13th, was the distribution from the booth of the Dictograph Products Corporation, of envelopes containing five Applause Cards.

These Applause Cards have been received with enthusiasm by the radio public, as it gives them for the first time, in a simple form, a means of showing their approval or disapproval, as the case may be, of the programs being rendered by broadcasting stations.

The radio public has become quite critical of the programs which are being furnished and stations, from time to time, ask expressions of opinion and approval in order that they may be able to keep in touch with the public's pulse and in order that they may be able to furnish to the public such entertainment as the majority seem to appreciate and demand.

The Applause Card was originated by the Dictograph Products Corporation, has been copyrighted and is being distributed by them to jobbers and dealers throughout the country and will be available for further distribution in radio shops everywhere.

This is the first organized effort to link up broadcasting listeners more closely with the stations from which they receive their amusement, and will bring about a much closer spirit of co-operation.

"Popular Radio Circuits"

THE Horne Electric and Manufacturing Company has just published a very comprehensive booklet on "Popular Radio Circuits," which should be welcomed by every enthusiast who comes into its possession.

They're all here—Reflex, Cockaday, Reinartz Tuned R. F. and the rest, and being fans ourselves, we are going to hold fast to our copy for future reference.

It gives us a fine feeling to know of a manufacturer like Horne, whose advertising literature is prepared with a view to really help the enthusiast first, and sell their products on the basis of a genuine service rendered.

Our guess is that this edition of the circuit booklet won't last long. Better drop a card today and be sure you get your copy.

Literature for Radio Fans

THE Jones Radio Company is to be complimented on the unique method of presentation they have developed for their latest circular showing Jones parts. The rear view of a set is illustrated, and from the various parts, such as transformers, rheostats, etc., diagrammatic lines lead the eye to type paragraphs below which explain the electrical and mechanical virtues of each item. The caption for this page reads "It's not the Face of the Watch. It's the works that tell the Story," which certainly is true of Jones equipment, we'll say. On the back of this sheet, the Jones "Liberty" audio transformer is featured in an attractive manner, together with circuit diagrams showing proper connections. The radio fans, for whom this was prepared will find it a handy piece of literature to have on hand.

Radio Operators in Demand

ACCORDING to recent advices from Washington, D. C., it is understood that approximately 100 first-class radio operators will be needed to fill vacancies on vessels of the U. S. Shipping Board during the next few months.

On the first of last July, the Government increased the pay of all its commercial operators approximately 15 per cent. The monthly rates of pay now in effect range from $85 per month to $125. A few positions pay a higher salary.

Radio operators aboard Shipping Board ships are classed as officers, and, in addition to their regular monthly pay, receive free lodging, meals and such other accommodations as are accorded to officers.

Applicants for berths as radio operators must hold commercial first-class radio operators' licenses, which are issued by the Department of Commerce. Examinations for such licenses may be taken at the offices of the Department of Commerce's Radio Supervisors, located at the following places: Custom House, Boston, Mass.; Custom House, Baltimore; Custom House, New Orleans; L. C. Smith Bldg., Seattle, Wash.; Custom House, New York; Federal Bldg., Atlanta, Ga.; Custom House, San Francisco, Cal.; Federal Bldg., Detroit, Mich., and Federal Bldg., Chicago, Ill.

Radio operators who desire employment on board Shipping Board vessels and holding required licenses should communicate with the radio companies which employ operators for the Board. These companies are: Radio Corporation of America, Ship Owners Radio Service, Inc., and Independent Wireless Telegraph Company, all of which have offices in large American ports.

New Headquarters for Fourth District

NEW headquarters for the Fourth Radio Inspection District have been established at Atlanta, Ga. Walter Van Nostrand, Jr., formerly of the Norfolk office, has been assigned to the new office. The Fourth District, which comprises the States of North Carolina, South Carolina, Florida, Georgia and the Territory of Porto Rico, was formerly combined with the Third District, with headquarters at Norfolk, but the growth of radio in the southeastern section of the country has made necessary the establishment of a separate headquarters for that section.

International Notes

By Charles Bailly

Paris

Want to Ban American Apparatus

FRENCH manufacturers of radio apparatus, fearing the competition of American and other foreign radio apparatus, are taking steps to prevent or lessen its importation. Both American and English parts are much liked by the French amateur, such apparatus as has reached the market being marked by great care in construction, excellent assembly, and complete practicality. Moreover, certain parts such as variometers, variocouplers and rheostats have not as yet been produced in France with entire success. In spite of the difficulties of the unfavorable exchange rates and the high tariff, American and English parts are being sold at retail in France at about the same prices as are charged for French and German apparatus. This can only be explained by the superior equipment of American factories, and the fact that manufacturing there is carried out in large quantities, with resultant major economies that are reflected in low prices. French apparatus of a similar nature is usually turned out by small manufacturers poorly equipped, relatively, and working with small outputs, the most expensive way of producing merchandise.

As for German radio articles, they may be made cheaply enough, but the export tax and the efforts of the Germans to make up for their depreciated currency by raising prices, results in their goods being laid down in France at figures comparable with articles from other countries.

The French National Syndicate of Electric Industries at a recent meeting voted a resolution demanding higher tariffs to remedy this condition. Since then, this body has begun the task of listing all radio parts that should thus be protected, and determining the tariff percentage that should be applied to each in order to protect the French radio industry. As soon as this work is complete it will be submitted to the authorities. The proposed new radio tariff rates are being worked out at about the figures to be found in the tariffs of other countries on the same materials.

Loop Reception of American Broadcasting

A FRENCH amateur, Mr. J. Plotard, has obtained particularly interesting results in receiving American broadcasting with a loop. During his experiments at night he has received under excellent conditions, among others, stations WOR and WHAZ, operating on 360 and 400 meters.

Plotard does not use a heterodyne. His receiver contains three stages of radio frequency, transformer coupled, a galena detector, and several stages of audio frequency, as needed. The crystal is connected in the secondary of the last radio frequency transformer, which also is provided with a .0005 variable condenser to tune the plate circuit and thus secure regeneration.

The loop consists of two turns separated 5 centimeters (1.95 inch) and is 4 meters by 2.5 meters (13.2 by 8.25 feet) in size, the wire is a large seven-strand cable.

Metallic Vibrations in Loud Speakers

IT is reported that a Belgian amateur, Mr. C. Dambal, is meeting with success in suppressing the metallic vibrations of loud speaker horns. He makes use of a composition of pitch from Judea and paraffin, dipping the horn in this mixture. The horn is subsequently covered with a very uniform coat of a dark brown fluid. Mr. Dambal states that the nasal quality of the horn is completely abolished and excellent quality is to be gotten from even poor horns after this treatment.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Guglielmo Marconi, *President* — J. Andrew White, *Acting President* — H. L. Welker, *Secretary*

Founded to promote the best interest of radio communication among wireless amateurs in America

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HEADQUARTERS: 326 BROADWAY, NEW YORK

RANKING among the best of school and institution radio stations in the East is that of the Newark Preparatory School. Early in the fall of 1922 a radio club was organized and, the sum of $2,000 appropriated by the trustees of the school. A honeycomb regenerative receiver with detector and two stages of radio frequency amplification was constructed and a Magnavox bought. All the broadcasting stations within a radius of two thousand miles have been heard with this outfit and amateur signals from nearly every district.

Wendell Kilmer, 2KX, who was instrumental in exposing the German radio station at Sayville during the war, has equipped his station with a loop antenna with which he tunes in the DX stations

Next, the CW, ICW and phone transmitter was built, the circuit being a modification of the well-known 1 DH, sure-fire circuit, using one 50-watt tube. Three thousand volts is used on the plate, supplied by the secondary of a 750-watt transformer. As this is A. C., the current is fed through a chemical rectifier to obtain pure CW. This rectifier was built by the pupils and consists of forty jars containing a saturated solution of borax, with electrodes of lead and aluminum. The current thus obtained being a pulsating direct current, a filter system was built, consisting of a 1.5 Henry choke coil in each lead and two condensers having a capacity of 2 mfd. across the line. A radio-frequency choke coil made by the members is also in the circuit. The filament current is obtained from a step-down transformer giving twelve volts. A rheostat on the primary of the transformer is used to counteract the changes in line voltage, The secondary is tapped at center which is kept at ground potential so that overloads will not injure the tube.

Modulation for the phone is obtained by use of a magnetic modulator in series, with which is placed a Western Electric microphone and six-volt battery. For ICW work a buzzer is substituted and a high note obtained. The grid inductances and antenna were made by the members. In the aerial lead is a hot wire ammeter by which the circuit is measured. The antenna is supported by two steel masts rising seventy feet above the street level. They are eighty feet apart and support an eight-wire cage "T" type aerial. The ground consists of the water pipes and sheets of copper and iron pipe buried in the ground. Experiments are now being made with a counterpoise in hopes of raising the radiation. Three amperes are now put into the antenna, and first, second, third, fourth and eighth district stations worked regularly. It is expected that in a short time signals will be heard from 2 BNT not only in every State in the Union, but also in Europe.

△ △

RANNY GALUSHA of the Caldwell High School Radio Club and expert trick circuit man, has gone and invented a circuit all by himself. He claims that he has a circuit, called the "Galusha circuit," that will make the Reinartz, Reflex and all the rest of the new trick circuits look like second raters. The big points of this circuit, we learn, are simplicity, ease of control, high amplification and last, but by no means least, cheapness of construction. All the circuit contains is a vario-coupler, variometer, two condensers, a dry battery, inserted in the ground lead, and a detector unit with as many steps of amplification as one may wish to put on it. The design and hookup seems pretty queer but its inventor claims that nothing can be compared to it for pulling in the distant stations. Incidentally, the circuit only works on broadcasting waves and higher wavelengths, no good results having been gotten on amateur waves. In other words, the hookup refuses to function on waves below 250 meters. Galusha admits that when two steps of audio-frequency amplification are used KDKA can be heard almost a block from the loud speaker, with closer stations coming in considerably louder. One of the unique features of the "Galusha circuit" is that the vario-coupler is inserted in the plate lead, which makes the working of the hookup all the more mysterious.

△ △

PARTICIPATION of French radio amateurs in the proposed trans-atlantic tests of this year was assured by Monsieur Leon Deloy, operator of French station 8AB, at the Second National A. R. R. L. convention recently held by the Chicago Radio Traffic Association.

Since he arrived in this country for the purpose of studying amateur conditions Monsieur Deloy has been conferring with amateurs on the precautions which must be taken in order to establish two-way communication between the continents. He says the difficulty lies in copying signals through heavy static and that with mild static low power signals could be more easily logged. Of the great number of amateur stations seen he said: "I have been impressed by the business-like way in which they are installed and operated.

"In France our transmitting stations are very much less numerous, for we have been allowed to transmit only a year and a half, but if their number continues to increase as fast as it has of late we will soon have a great many stations. We are not allowed to exchange messages and we can only use our transmitters for experimenting. That is why the average station over there is built somewhat differently than here. In France we are greatly interested in trans-atlantic communication with the amateurs of this country. A big effort is being made now and many good stations should be ready to bridge the Atlantic very soon."

△ △

RADIO operators seeking employment will find excellent opportunities this fall for real radio work on board ships of the United States Shipping Board, which

sail the seven seas and call at every port in the world.

The annual turnover of radio personnel is large, due to several causes, among them being the fact that many college men spend their summer vacations sailing the "briny deep," as marine radio operators, and then return to their studies at the end of the vacation season.

It is understood that approximately 100 first-class radio operators can be placed on government vessels alone during the next few months.

The government, July 1 last, increased the pay of all its commercial operators approximately 15 per cent. The monthly rates of pay now in effect range from $85 per month to $125. A few positions pay a higher salary.

Radio operators aboard Shipping Board ships are classed as officers and, in addition to their regular monthly pay, receive free lodging, meals and such other accommodations as are accorded to ships' officers.

Applicants for berths as radio operators must hold commercial first-class radio operators' licenses, which are issued by the Department of Commerce. Examinations for such licenses may be taken any time at the offices of the Department of Commerce's radio supervisors.

Radio operators who desire employment on board Shipping Board vessels and holding required licenses should communicate with the radio companies which employ operators for the board.

THE United States Civil Service Commission announces a competitive examination for radio operator. Receipt of applications will close November 20. The examination is to fill a vacancy in the Bureau of Agricultural Economics, Department of Agriculture, at an entrance salary of $1,400 a year, plus the increase of $20 a month granted by Congress, and vacancies in positions requiring similar qualifications.

Applicants must have completed eight grades of common-school or equivalent education, and have had at least six months' experience as commercial radio operator on board a vessel or at a wireless telegraph station, or one years' general experience as radio operator in other than commercial work.

Competitors will not be required to report for examination at any place, but will be rated on the subjects of education and experience. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil-service examiners at the post office or custom house in any city.

A NEW and practical course in radio for beginners is one of the features added to the night courses for the coming year at Carnegie Institute of Technology, Pittsburgh, Pa. Decision to give this new course was made as a result of the apparent demand developing from the widespread interest in radio communication in the Pittsburgh district.

The work will be covered in one year of two terms extending from September to May, and the course has been prepared to appeal especially to amateurs, school teachers, salesmen and dealers in radio apparatus. No previous knowledge of electricity or radio is required, says the announcement. Instruction will be given on Tuesday and Friday nights and will be covered by lectures, demonstrations, and laboratory practice.

The subjects incorporated in the work include elementary electricity covering magnetism, resistance, inductance, and capacity; methods of transmitting energy; properties of wave motion; theory of production and reception of electro-magnetic waves; antenna wavelength and measurements transmission and reception of damped and undamped waves; vacuum tubes, their operating characteristics, uses as detectors, amplifiers and oscillators; radio telephony, methods of transmission and reception; code practice in continental Morse code to a speed of 10 words per minute.

A miniature five-tube radio frequency, detector and audio frequency set using UV-199 tubes built by Sidney Kasindorf of New York and exhibited at the recent N. Y. radio show

---

THE German Radio Club established in Berlin earlier in the current year has already attracted a considerable membership and is at present endeavoring to bring pressure to bear upon the Government to relax the restrictions under which private installations are prohibited, the whole matter of radio being under the official control of the Posts Administration.

It is surprising that private radio enterprise in Germany is so far behind other countries. Commenting upon this circumstance at a meeting of the Radio Club a well informed speaker interested a large gathering of members with an outline of recent radio progress and cited the experimental work of Slaby, Braun, Graf, Arco, Goldschmidt and the Meissner Brothers, as deserving of special appreciation. It is, he said, to the Meissner Brothers that the world is indebted for the present method of amplification which makes possible the manufacture of the small pocket sets now so popular in the United States. A small closed circuit (loop) antenna was practically demonstrated by the speaker by means of which London could easily be heard. He concluded his lecture by saying that whereas in former times Germany was well in the front in radio matters, it was now far behind, as a result of official opposition to individual initiative.

Book Reviews

New Signal Corps Pamphlet

A PUBLICATION giving an introduction to the subject of line radio communication has just been prepared under the direction of the Chief Signal Officer of the Army in co-operation with the Bureau of Standards. The pamphlet gives an explanation of how messages are carried to distant points by radio frequency currents directed over ordinary telephone lines or power wires. The fundamental principles of radio and its relation to line radio telegraphy and telephony are discussed.

Copies of the work, known as Signal Corps Radio Communication Pamphlet No. 41, and entitled "Introduction to Line Radio Communication," can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents per copy.

Pamphlet on Amplification Measurements

MEASUREMENTS of voltage amplification of audio frequency amplifiers are discussed in Letter Circular 98, which has just been issued by the Bureau of Standards for free distribution. This circular gives the results of voltage amplification measurements made on 16 audio frequency amplifiers which were on the market during 1921-22. All these amplifiers employed transformer coupling. Measurements were made over a frequency range of 400 to 2100 cycles per second. The amplifiers studied are referred to by arbitrary reference numbers rather than by a statement of the manufacturers' names and model number, the method followed being the same as that used in measuring the voltage amplification of amplifiers, the subject of Letter Circular 86.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. Lists will be published in issue immediately following receipt of list. Spark and C. W. stations should be arranged in separate groups.

9ZT, D. C. WALLACE, 54 Penn Ave., North Minneapolis, Minnesota (September).

C. W.—(1aw), (1er), 1jz, 1uh, 1abc, (1abs), 1acu, (1adn), 1ajp, 1ake, (1ava), 1bbo, (1bcf), (1bcg), 1bkq, 1bom, 1bsj, 1bvb, 1bwj, 1ckp, (1cmp), (1cpo), (1crw), 2fp, (2gk), 2rb, 2rm, 2rs, 2afp, (2agb), 2awh, 2bmr, 2bqh, (2brb), 2bsc, 2bvc, 2ccx, (2cfb), (2cqz), ccvu, 3gs, 3hh, 3iw, 3tj, 3tm, 3abw, 3bji, 3bva, (3bvl), 3ccu, (3chg), 4af, (4ai), (4cs), 4dx, 4eb, 4ft, (4ku), 4mb, (5fx), 5ga, 5ge, (5gm), 5gn, (5lr), 5mn, 5mo, 5pb, (5ql), 5qq, 5sf, 5uo, 5sk, (5za), 5abn, 5afn, 5agj, 5aic, 5aiu, (5akn), 5ama, (5amb), 5anf, 5xad, (5zav), (5zax), 6ec, 6hp, (6km), 6pl, 6acg, (6age), (6ajd), 6alk, (6alv), (6aos), (6arb), 6atz, (6aws), (6awt), 6bkx, (6pz), (6bqb), (6brf), (6bru), 6buo, (6bvg), 6bvn, 6byu, (6cbu), (6cfz), 6cgd, 6cgw, (6chl), (6cpy), 6cpz, (7bj), (7dc), 7dw, (7fd), (7ly), 7wp, 7ya, 7yl, (7zd), (7zf), 7zl, (7zn), 7adp, (7afe), (7agv). CANADIAN—2bn.

Queries Answered

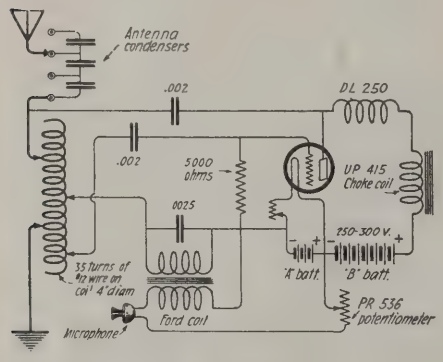
Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no questions answered by mail.

M. N. Field, Scranton, Pa.

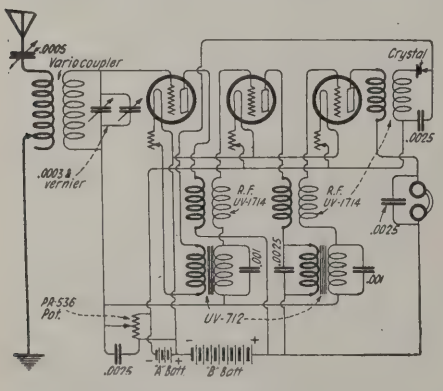
Q. I would be very much obliged to you if you would draw a circuit for me showing a combination receiver and phone transmitter. I would like to use one 5-watt tube in the circuit. What would be the maximum wavelength of transmitting?

A. We would not recommend the use of a transmitting tube for reception. The transmitting circuits do not lend themselves to ease of tuning and the results you will obtain will be far from satisfactory. Below is hook-up for 5-watt phone transmitter. The maximum wavelength for transmitting is 225 meters.



I. Heilweil, Bronx, N. Y.

Q. Would like, if possible, a diagram of a reflex three-tube set using a crystal as detector. Can dry cell tubes be used with same? If so, what difference in tone quality and volume? Can a Reinartz flat coil be used with same?



For greatest volume, UV-201-A Radiotrons or C-301-A are best. The UV-199 will also give good results. A Reinartz coil may be used instead of the variocoupler.

* * *

Charles H. Keiser, Watervliet, N. Y.

Q. 1. Recently I constructed a four-tube reflex Neutrodyne set according to drawings in April issue of THE WIRELESS AGE on page 58, but I am unable to get distant stations, although nearby stations come in with considerable volume and clarity. Will you kindly give me the following information. Are the primary and secondary windings of the radio frequency transformer wound in same direction?

A. 1. See "Queries" columns of previous issues of THE WIRELESS AGE for direction of windings of Neutrodyne.

Q. 2. How may a balance be obtained in regard to windings opposing each other in polarity?

A. 2. A careful study of Mr. Ringel's article will show how neutralization is obtained.

Q. 3. Is there any difference between the UV-712 and UV-712* audio frequency transformers and how should they be used in a Neutrodyne circuit with regard to reflex audio and external audio?

A. 3. The UV-712 has a 9 to 1 ratio and the UV-712* has a 3 to 1 ratio. The latter gives much better quality of reproduction. It is difficult to obtain distant reception in the summer time. Try a UV-200 as a detector and try regeneration by means of a variometer in the plate circuit of the detector tube. All the condensers must be set to within a fraction of a degree.

* * *

R. K. Temple, Lynchburg, Va.

Q. Kindly let me know if there is an accurate formula in any of the publications you handle for figuring the inductance of a coil containing an iron wire or silicon steel core, either straight core or closed magnetic circuit.

In the formula

$$L = \frac{4\pi^2 r^2 N^2 \mu}{1 \times 10^9}$$

the permeability μ derived from B. & H. as shown in chart for silicon steel, varies with the amperes passing through the coil. In speaking of an iron core coil of 30 henries inductance do you mean 30 henries under certain conditions only? If so, what conditions?

A. The inductance of an iron core coil will vary with the amount of magnetization, but the formula

$$L = \frac{4\pi^2 r^2 N^2 \mu}{1 \times 10^9}$$

is rough approximation. An empiric formula for an open iron core inductance is

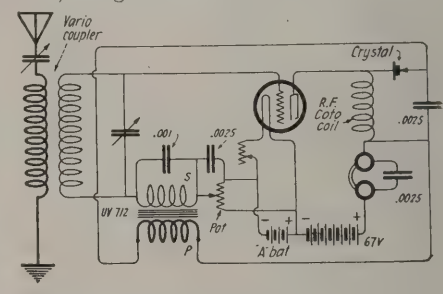
$$L = \frac{(0.00042\ l + 0.00012S)\ N^2}{3140}$$

where l = length of core in inches
S = cross section of core in square inches
N = number of turns
L = inductance in henries.

If you wish to make a standard inductance, it should not have an iron core. If an iron core inductance is specified as 30 henries it means that it is the approximate value with only a small amount of current in the windings.

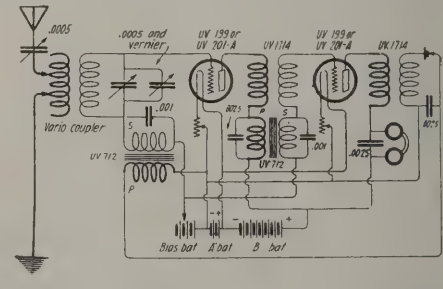
Paul B. Ferris, Champaign, Ill.

Q. In the May issue of THE WIRELESS AGE under the article "A New Reflex Circuit," by Stanley Russell, a Cotocoil radio transformer is stated to have been used. Will you please give me a hookup with such a coil, using the one-tube reflex circuit?



W. A. George, Omaha, Nebr.

Q. Will you please publish a circuit suitable for two dry cell tubes and crystal detector which will provide for the maximum radio frequency and audio frequency amplification, giving values? Referring to figure 1, page 61, May issue of THE WIRELESS AGE, could another tube, radio frequency transformer and audio transformer be added to this circuit and how many stages of radio and audio would result? Referring to figure 2, page 60 in the January issue, could a crystal detector be substituted for the detector tube in this circuit?



A. See diagram. We recommend this hook-up as most suitable for your purpose. It contains two radio and two audio stages. A crystal detector may always be substituted for a tube detector, providing that no regeneration is desired.

* * *

Russell A. Lange, Hawley, Pa.

Q. Please give me directions for winding a loop aerial. What size wire and number of turns, on what size of frame?

A. Wind 14 turns of No. 18 annunciator wire (or 20 x 38 litzendraht) on a frame 30 inches square. Space turns ½ inch apart.

* * *

Howard G. Sommers, Philadelphia, Pa.

Q. Will you kindly advise me as to how to connect a potentiometer on a 3-tube Copp circuit?

A. We have no knowledge of the "Copp" circuit.

SHAW

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Benjamin Electric
Russell-Stoll
Lanston Monotype
U. S. Cloth Cutting
Thomas & Betts
Hanovia Chemical
Ward Motor Vehicle
Callaphone
Klosner
Wireless Improvement
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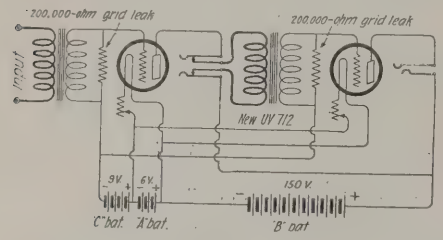
George Cook, Brooklyn, N. Y.

Q. I have a detector and two steps of amplification and get signals loud enough to be heard all over the room, but we have a number of parties in our house and what I would like to have is a hook-up of a two-step power amplifier so I can place the loud speaker in the basement and have the music loud enough to be heard good on top floor of a two-family house. I have two extra 201-A tubes, and please let me know if they can be used in the power amplifier?

A. If you wish to have the receiver in the basement, why not run a pair of wires



up to the loud speaker (which you will place on the second floor)? Below is a hookup for a two-stage power amplifier, using UV-201-A or C-301-A tubes.

* * *

John M. Gates, Pasadena, Calif.

Q. Can you advise how I can make the Grebe CR-5 circuit more selective for distant stations when local stations are broadcasting? My set is quite sensitive. I have heard stations 2,500 miles away.

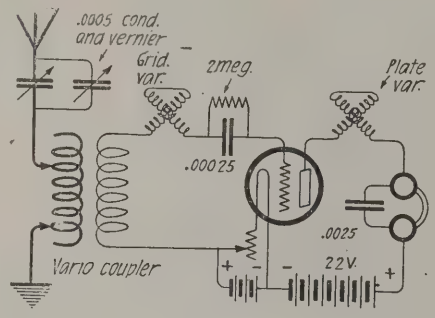
A. We would advise that you get in touch with A. H. Grebe & Co., Richmond Hill, New York. They provide a tuned radio frequency amplifier which will not only give greater range of reception, but also greater selectivity. This unit is the type RORN amplifier.

* * *

F. T. Wilcox, Schenectady, N. Y.

Q. My object in ordering the June issue of THE WIRELESS AGE was to obtain detailed information as to the value of a circuit consisting of variocoupler and two variometers, and detailed instruction as to its construction and operation. My desire is to make a set for dry cell operation, having the best receiving qualities for broadcasting stations, and I thought the above would cover it.

A. Below is circuit you desire. The panel should have tinfoil or copper fastened to the rear, so that the capacity of your hand will not change the tuning. This shield should be connected to ground. Your own experience will teach you the best way to operate it.



* * *

Lee Bates, Springfield, Mo.

Q. 1. Taking into consideration the time spent in searching for stations with a selective set, which is considered best for relay work, a selective set or a single circuit?

A. 1. A single circuit set will enable you to pick up weak stations more easily than the usual two circuit set.

Q. 2. Does a cage-aerial with the lead-in at one end show a directional effect? If so, in what direction from the aerial?

A. 2. The directional effect is noticeable only when the horizontal portion is more than four times the length of the vertical portion. The best transmission is then in the direction away from the open end. Even at best, the directional effect is noticeable only up to a radius of about 20 miles.

Q. 3. Is it true that when the lead-in is connected between the center and end of an aerial that energy transmitted is divided into two different wave lengths? What would be the difference between such a condition and the two parts of a pure wave?

A. 3. No.

Q. 4. What is the code signal representing the dollar mark?

A. 4. It is usually spelled out, although "SX" is frequently used.

Q. 5. Is there any way to obtain the publication, "The Proceedings of the American Association of Radio Engineers"?

A. 5. You may join the Institute of Radio Engineers (as an associate member) and you will then receive the proceedings regularly. We would advise that you address the Secretary of Institute of Radio Engineers, College of the City of New York, New York City, and ask for information regarding membership in that organization.

Q. 6. Using a cage aerial and a cage lead-

Hommel Passes 100%

What About Your Jobber?

Q. Why is a radio jobber?

A. To give service to radio dealers.

Q. Does he retail and thus compete with his dealers?

A. Hommel does NOT retail, but refers users' inquiries and orders to his local dealers.

Q. Does he handle nameless products for his greater profit?

A. Hommel handles only nationally advertised, reliable apparatus.

Q. Can he ship all the dealer's requirements—tubes, sets and parts?

A. Hommel can and does it promptly. His dealers need not split their orders.

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in how much effect on the natural period of the system does the length of the lead-in have?

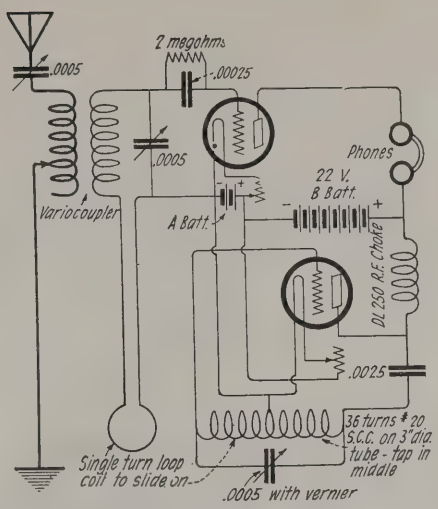
A. 6. The lead-in does affect the natural wave length of your aerial. The natural wave length may be computed by multiplying the total length of the aerial, flat top and lead-in, in feet by 1.40. This will give approximately the fundamental wave length in meters. See E. E. Bucher's "Practical Wireless Telegraphy."

Q. 7. If the aerial was erected on the roof of a house, would a well insulated counterpoise in the basement have the desired effect?

A. 7. A counterpoise in the basement would not have the desired effect.

Q. 8. Please show a good heterodyne receiver that is fairly easy to operate.

A. 8. Receiver using external heterodyne.



F. H. Batton, Springfield, Mo.

Q. Kindly give me the wavelength (approximate) that the reflex circuit on page 61, May issue, responds to figure 1, and figure 2. As the natural wavelength of r.g. coil No. 50 is 114, and a short aerial is specified for this circuit, I do not see how it could respond to more than about 300 meters, entirely inadequate. Will WD-12 tubes do for figure 2?

A. The circuit shown will tune up to about 600 meters. A single set of radio and audio transformers is sufficient.

* * *

Lee Epperhart, New Westminster, B. C.

Q. 1. Is the enclosed diagram of one-stage radio, detector, and two stages audio all right? If not, can you give me a hook-up showing only the instruments used in

Concessions on tremendous purchases for our enormous production makes it possible for us to again slash battery prices. Thousands of Wireless Age readers will profit by these prices, but they will have to act quickly. Everyone knows the costs of materials are rising. Order today!

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For UV-199 tubes. Same features as 2 Volt.

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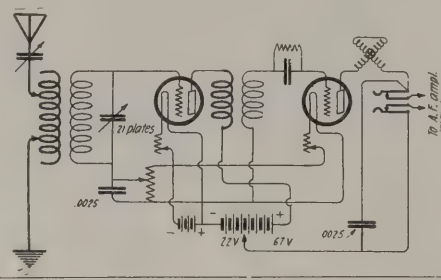
the enclosed hookup, as I don't want to use any other instruments, such as another variometer, as I would have to completely change the front of my cabinet. I especially want the three four-contact jacks shown in the circuit. I am going to use a separate cabinet for the two-stage amplifier, and will use two sets of dry cells (two "A" batteries) for my WD-11 tubes. At present I am using detector and one-stage audio.

A. 1. The diagram you enclose is not entirely correct. You have made no provision for tuning the grid circuit of the radio frequency amplifier. The variometer should be inserted in the plate of the detector tube and a blocking condenser connected across the jack. The corrected wiring of the radio frequency amplifier and detector is shown below. You will not require any additional equipment outside of a potentiometer and fixed condensers.



Q. 2. If the enclosed hookup is all right, is there any way in which I can improve upon it?

A. 2. If you wish to obtain loud speaker operation from stations at a moderate distance, or even a great distance, on favorable occasions, one radio frequency and two audio frequency is best.

Q. 3. Which do you consider the better, one radio, and two of audio, or two radio and one of audio?

A. 3. If you wish to get consistent distant reception on head receivers only, two radio frequency and one audio frequency is advisable. We recommend the former as more desirable.

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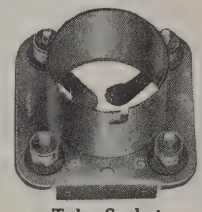
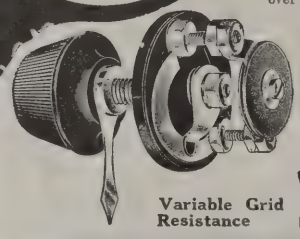

Tube Socket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Variable Grid Resistance
Inductance Switch
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1923
1922
1921
1920
1919
1918
1917
1916
1915

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Complete 3000-Ohm set with cord and head band; aluminum back; brown-red ear caps; small, light-weight; exquisitely sensitive and fine-toned.

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Complete 2000-Ohm set of new design; a remarkable production with the same workmanship and guarantee as on our standard Model "F".

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THE GUARANTEE
Money back if after 7 days' trial you're not satisfied that "Red-Heads" are the BEST receivers on the market at the price.

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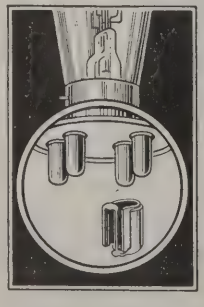
Dept. RD, E. 12th Street, Cleveland, O.

GAMBLING?

YOU ARE IF YOUR RADIO TUBES ARE UNPROTECTED



Your Vacuum Tubes are the most delicate parts of your Radio Set.

They are easily blown out—you have probably already had this exasperating experience—it is apt to happen at any time.

"B" Battery wires accidentally crossed for only an instant with the filament leads or sudden excess current from the "A" Battery will do it.

You can prevent this and save yourself money and inconvenience and relieve your mind at a trifling cost.

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on all your tubes. Applied in an instant to one of the filament terminals. Will fit any standard tube going in any standard socket.

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Equally good for all distances.

A loud speaker of superior qualities. Reproduces signals with no distortion at high amplification. A home instrument at a very moderate price.

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Royalfone
KING OF ALL

Q. 4. Will a 21-plate variable condenser across the secondary of the variocoupler help any?

A. 4. The 21-plate condenser across the secondary is shown in the diagram.

Q. 5. Why is there so much difficulty experienced by amateurs when operating or trying to operate radio frequency amplification?

A. 5. Difficulty is experienced in operating a radio frequency amplifier when using only a single circuit receiver, and in not taking the necessary precaution about using very short connections. It is also worth while to try various tubes in the radio frequency stages to determine which works best.

Q. 6. In the cooler months, what is the average range of one stage radio and two of audio?

A. 6. The average range of one radio frequency and two audio frequency is about 1,500 miles and probably more when good conditions prevail.

* * *

Peter R. Copping, Jr., New Orleans, La.

Q. 1. In the October issue of 1922 on pages 82-83, Mr. Ames of Baltimore asks for a hookup using certain radio apparatus to speak to his friend a few squares away. You gave him a hookup which you said he could use to speak to his friend. Now I am using a WD-11 tube in a circuit I am enclosing. Do you think a microphone in the ground lead of this hookup would enable me to speak to my friend about 2 or 3 squares away? Will the WD-11 tube stand 100 volts on the plate?

A. 1. A microphone in the ground lead may not be enough to communicate 3 or 4 squares. Better try it first and if it does not work, add a Ford coil as shown in the diagram. Yes.

Q. 2. Would I be able to speak to my friend with a lower voltage on the plate of my tube?

A. 2. It is best to use a fairly high voltage.

Q. 3. If the hookup I am enclosing will not work satisfactorily, please give me a hook-up, using as much as possible the apparatus mentioned in the diagram I am enclosing.

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21 Academy Street

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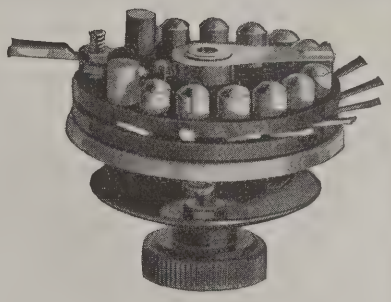
12 Point Rotary Switch

This switch is designed to solve one of the most vexing problems of the amateur and professional builders of radio receiving sets. It eliminates unsightly front of board contact points, providing a complete unit for rear of panel mounting, to which variocoupler taps may be easily soldered. It is held in place by two mounting screws, heads of which are neatly covered by the indicating dial. The knob and dial are mounted on adjustable shaft held by set screw for any thickness of panel up to 3/8".

This switch may be used with a voltmeter for reading voltage of individual tube filaments.



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Trade Discounts on Application.

LIST PRICE $1.50

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THE STERLING MANUFACTURING COMPANY

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MICROMETER ADJUSTING

CRYSTAL DETECTOR

Increases the Efficiency of Your Crystal Set

Finer tuning, clearest possible reception; constant adjustment until you wish to change, then—"A Twist of the Wrist—It's Set." Excellent for reflex and other circuits. *Write for folder and name of your nearest dealer.* $2

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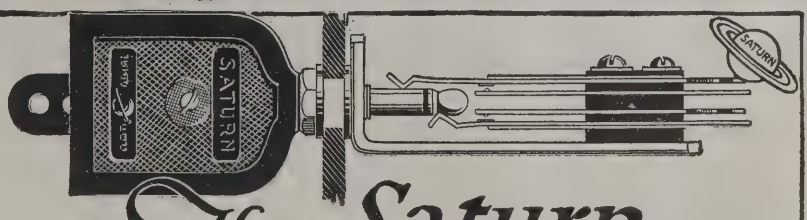
Exclusive Factory Representatives

39 William Street, Newark, N. J.



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Automatic Plug

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No. 1	Single Circuit	Open	50c.
No. 2	Single Circuit	Closed	55c.
No. 3	Double Circuit	Closed	70c.
No. 4	Single Filament	Control	75c.
No. 5	Double Filament	Control	80c.

The Saturn Mfg. & Sales Co., Inc.

48 Beekman Street

New York, N. Y.

A. 3. See answer to Question 1.

Q. 4. Please give me full instructions covering the operation of such a set.

A. 4. In order to operate the set, adjust the tickler coil and obtain strong oscillations. Be sure that you are below 200 meters. Best operating adjustments will be found only by experimenting with plate voltage, grid condenser, grid leak, and other variable units.

Q. 5. Will the reception be changed any by adding a microphone in the ground lead, or would it be advisable to use a switch to connect the microphone in series with the ground lead or disconnect at will?

A. 5. It is best to short circuit the microphone whether in the ground lead or in the new connection shown, since it will probably pick up local sounds and thus interfere with reception.

C. F. G. Neuhaus, Chicago, Ill.

Q. 1. I desire to build a receiving set capable of receiving broadcast music, with a range of 2,000 miles or more, *i. e.* Pacific Coast radio stations. Can you enlighten me as to the best hook-up known at this time?

A. 1. The best hook-up for receiving from great distances is the super-heterodyne which requires the use of about 7 or 8 tubes for best results.

Q. 2. I have read with interest your article on the Neutrodyne receiver in the April issue of THE WIRELESS AGE, and if this is your recommendation at this time I would like to ask several questions before beginning to build same. Are the coils, primary and secondary windings alike? Are they both wound clockwise or anti-clockwise, away from you when assembled and looking down into both of them?

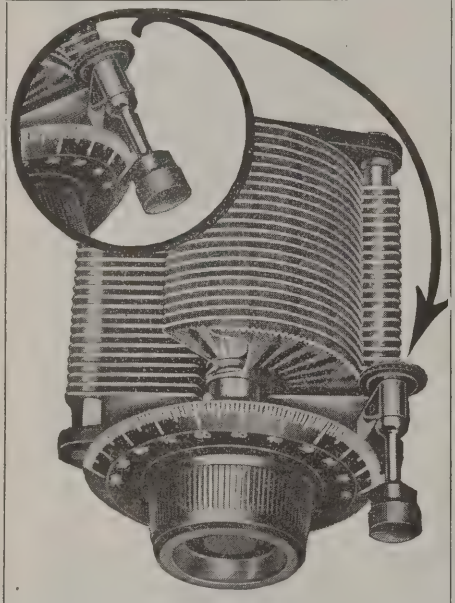
A. 2. Both primary and secondary windings of the Neutrodyne are wound in the same direction, but connection is so made that from the grid terminal, the secondary appears wound in one direction, and from the plate terminal the primary is wound in the opposite direction. See other "Questions and Answers" in this issue.

Q. 3. This same article speaks of the condenser as being of the 11-plate type, with a maximum capacity of .0005 microfarads. Which is correct?

A. 3. The condensers used may be either 11- or 13-plate.

Q. 4. I will probably want to build the one shown in figure 11, Reflex Neutrodyne, but would like a range of from 180 to at least 600-meter wavelengths. What will I have to do to get this?

A. 4. To go up to 600 meters, wind 18 turns on primary and 70 turns on secondary.



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Now the "guess" has been taken out of condenser buying. The source of greatest uncertainty, the plates, by a new process of stamping and tempering in **Heath's Radiant Condensers** are PERMANENTLY FLAT. They are as proof against warping and buckling as a steel straight edge. These condensers will keep their fine alignment without any adjusting during **their entire life!**

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Ordinary vernier adjustment reduced to micrometer fineness. Extreme delicacy of adjustment. Smooth, positive, accurate as a watch. **Heath's Radiant Condensers** are especially adaptable to the fine tuning required on high amplification.

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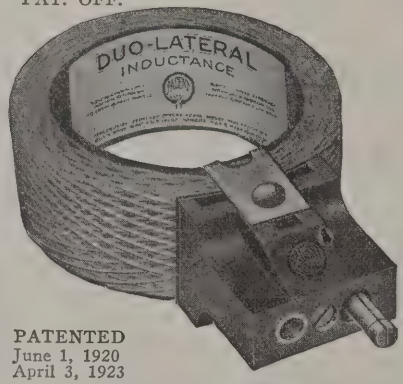
*Duo Lateral Coils Mounted

*REG. U.S. PAT. OFF.



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THE WIRELESS AGE

"America's Foremost Radiophone Review"

VOLUME XI DECEMBER, 1923 NUMBER 3

How Iwaki Told the World

By Col. Samuel Reber

Representing the Radio Corporation of America in Japan

Overlooking Haranomachi where the transmitting station of the Japanese Department of Communications is located

GENERAL SHERMAN said "War is hell," and he knew. Earthquakes and their resulting fires are worse, and I know as I have been through both. What happened in Tokyo and Yokohama on the first and second of last September is unthinkable and incomprehensible to one who did not go through those soul-trying days, for the imagination of a Dante and the pencil of a Doré can hardly portray the horrors of that Japanese inferno. Yokohama was entirely wiped out; Tokyo a mass of flames; two million homeless wanderers seeking a place of safety in the streets and parks; families separated; children lost by the thousand, all hungry and thirsty; more than a hundred thousand dead and missing; all bridges, railroads, telegraph and telephone circuits gone; all radio stations destroyed or without power as the hydro-electric transmission lines began to fail. The smoking ruins of that great city stood completely isolated in its misery with no communication to the outside world. Constant earth shocks accentuated the terrors of the tired populace which had justed passed through a night of horrors. Greater misery and woe were impossible.

Radio was first the herald of disaster and then the messenger of hope. It told the world of the horrors, brought the glad tidings of help with the speed of light, and echoed the sympathy of all mankind.

Having tried, the night before, to reach the embassy and having been cut off by the fire, I went there early Sunday morning where I found the American ambassador, Mr. Cyrus E. Woods, calmly surveying its smoking ruins from which he and his family had with great difficulty escaped with their lives, and planning to meet the grave problem of immediate relief for the sufferers. America may well be proud of her representative, as he embodies all the qualities that characterize the best type of our nation. His name will be ever linked with that of Perry in all future histories of Japan. His first thought was to get the news to Washington and ask for food for the hungry, as he clearly foresaw the conditions of the coming days. He asked me if I thought I could get a message through to the Secretary of State and I told him that I would, as I was confident that the radio station at Funabashi must be working, and, as it is less than 20 miles

from the city, I felt confident that the Navy Department would find some way to get the message there. He then dictated to me the following message:

Tokyo, September 2nd.

Secstate,
Washington.

All Americans (in Tokyo) believed safe stop all embassy buildings totally destroyed but no one in embassy injured stop food situation very acute stop send rations at once from Philippines.

Woods

(Note. Filed by S. R. at the Navy Department at 10 a. m., Sept. 2nd, sent by messenger to Funabashi and transmitted by radio to Iwaki which received it 3:30 p. m., Sept. 4th, and sent it to Honolulu. It was received at San Francisco which was listening in for anything from Japan at 10:58 p. m., Sept. 3rd. which corresponds to 4:20 p. m. Sept. 4th, Tokyo time.)

In company with Mr. John K. Caldwell, the Japanese Secretary of the Embassy, who, though he had lost his all in the fire and had been without sleep the entire night, had reported early that morning to the Ambassador, I went straight to the Navy Department, which was crowded by the refugees as the authorities had thrown open the building as an asylum to the homeless, and finally fortunately found Commander Y. Ko, of the Imperial Japanese Navy, Secretary to the Minister of Marine, to whom I explained my mission through Mr. Caldwell, as I unfortunately can speak but a very few Japanese words. Commander Ko took us to a spot in the grounds of the Department where under a large tree with a plank supported on two barrels underneath it, were several naval officers who were receiving the official messages from the several branches of the Japanese government for transmission by messenger to the Navy radio station at Funabashi. While Mr. Caldwell was copying my message in legible script, Commander Ko conversed with me in very good English, somewhat to my discomfiture, as I had possibly put the case more plainly than the chosen words of diplomacy might suggest. Twice again, that day, the ambassador entrusted me with the dispatch of other messages which were sent through the same channel.

K. Yonemura

The Radio Hero of the Japanese Disaster tells how he gave the world its first news from stricken Yokohama.

This thrilling story, the first to come direct from the lips of operator Yonemura, has been obtained exclusively for the readers of THE WIRELESS AGE.

This successful bridging of the awful chasm which earthquake and conflagration opened up between the Island Empire and the rest of the world, from which help must be summoned, will go down in history as one of the most important feats of radio and one of the milestones of wireless communication.

But even here the wonderful mechanism which human ingenuity has contrived would have been tragically useless but for the heroic human devotion of operators.

This is the story of how radio operators stuck to their job in the midst of devastation and terror.

Tokyo, September 2nd.

Secstate,
Washington.

Communications have just been opened with Yokohama stop the situation there is very serious and it is thought some Americans have lost their lives stop the casualties in Tokyo are estimated at ten thousand stop I believe all Americans here are safe stop the food situation will soon be acute send supply from Philippines at once as requested in my message of this morning stop the fireproof vault of the embassy was not fireproof and all embassy records were destroyed.

Woods

(Note. Filed at Navy Department at 9:30 p. m. Sept. 2nd by S. R., sent by messenger to Funabashi, transmitted to Iwaki by radio and received by Iwaki at 11:55 a. m. Sept. 5th, forwarded to San Francisco by radio and received there at 6:59 p. m. Sept. 4th which corresponds to 12:21 p. m., Tokyo time.)

Tokyo, September 2nd.

Commanding General,
Philippine Division, Manila.

The food situation here is acute stop please send supply by fast boats stop it is estimated that ten thousand lives have already been lost in Tokyo and the situation in Yokohama is probably worse.

Woods,
Ambassador

(Note. Filed by S. R. at 10:40 p. m. at the Navy Department, sent by messenger to Funabashi, transmitted by radio to Iwaki, Sept. 6th, 7:34 p. m. relayed by the U. S. Naval radio at Pearl Harbor to Cavite.

* * * * *

The following will be helpful in understanding the story of the Superintendent of the Iwaki radio station, Mr. K. Yonemura, who is the oldest radio operator in length of service in Japan. The Iwaki radio station is the high power station of the Department of Communications and forms the western end of the transpacific circuit of The Radio Corporation of America, the receiving and control station being at Tomioka, some one hundred and fifty-two miles north of Tokyo and the transmitting station at Haranomachi some twenty miles further north. This station is the Japanese outlet for the larger part of the Pacific transoceanic traffic exchanged between the U. S. and Japan, working with the high power stations of the Radio Corporation of America at Honolulu and San Francisco. Funabashi, the high power station of the Imperial Japanese Navy, is located at the head of Tokyo Bay, some twenty miles from the city, while Choshi, Shiomiasaki, and Shimotsui are coastal stations of the Department of Communications (the Teishinsho) for ship to shore service. Choshi is on the coast nearly due east of Tokyo near Cape Inubo, Shiomiasaki near Cape Ushio in Wakayama Prefecture

(*Continued on page* 48)

The receiving and control station at Tomioka

Costumes and Action in the Studio

The famous Grand Guignol troupe from Paris, now playing in New York, broadcasting a thriller in the French language from WOR. Their specialty: vivid drama

Clothes perhaps don't make the man, but when Jud Landon parades some fishing gear and old clothes he can tell a fish-story from WGY more convincingly

A "Farmer's Night" staged in the studio of WGY. Where several artists are rendering their combined effort before the microphone, the realistic effect produced by appropriate costuming and gesture reacts upon the artists themselves. Entering into the spirit of their act in this thorough fashion, they produce a more appealing entertainment. The listener is almost able to see the costumes and acting through his receiver

Popular People and Events by Radio

Edith Bennett, concert star, sings in Navy Day program at Electrical Exposition to radio accompaniment from WHN

Dorothy and Lillian Gish—saying good-by from WJZ to their host of friends before sailing to Italy to start a new picture

Football game delivered via Radio. The control tower at Franklin Field in Philadelphia, from which the radio announcer describes the gridiron battle, play by play

This "People" is not very big, but little fellers like him are "Popular" the world over. He doesn't have to "watch the birdie" any more. Radio sings and talks and whistles to divert his gaze and keep him quiet

MUSICAL Comedy Reduced to Wave-Lengths. A short time ago radio fans were treated to a choice bit from the popular "IRENE," when the KING SISTERS, Mary and Jane, broadcasted from WJZ

Opportunities In Radio Today

There's a Good Position Waiting for the Right Man. Six Different Ways of Breaking Into the Game

By Pierre Boucheron

"I WANT to get into radio. How can I do it?" This is the burning question which has been asked of me and probably of every other pioneer radio man during the past year. School boys in short pants, young men just out of college, clerks and all manner of business men, salesmen, middle-aged men who are past forty; old-young men who are past seventy and who are still in the running in spite of what Dr. Osler said ten years ago; girls and women—all have asked the question of the hour: "How am I to get into this radio business?"

Judging from these healthy questions, one would think that radio is the open sesame to all ills; that it is the happy solution of everyone's career problem; that it is all joy and no sorrow; that there is plenty of money to be made in it. All one has to do apparently is to get into it and the sooner the better and frequently with little thought as to qualifications.

There are so many jobs to be filled in as many different branches of this big industry that it would perhaps be a good thing if I enumerated each one at this time and take up the factors connected with each afterwards.

As I see it, there are six main branches. These are:

1. Commercial Radio Operating
2. Engineering
3. Manufacturing
4. Broadcasting
5. Merchandising
6. Publishing.

Perhaps the most romantic and common start of many who are today leaders in this art is that known as commercial radio telegraph operating. As a matter of fact, these leaders, especially in the commercial and executive branches, started out as amateur radio operators and then branched out as commercial radio operators. There are two broad divisions in commercial radio operating. The first is the marine operator. This individual usually get his start as an amateur by learning the Continental code and communicating with his nearby amateur friends, first painfully slow in his speed of reception and finally becoming an expert relay man, handling non-commercial messages clear across the country. I am referring particularly to that great body of men associated with the *American Radio Relay League*. Later, the fascination of radio telegraphy, plus the desire to travel and see new worlds, becomes uppermost in the young man's mind and we see him taking the examination for a commercial operating license at the local inspector's office. A few weeks later he is upon the high seas on a tramp, tank steamer or a large sailing vessel.

For a few years he roams the seven seas, graduating from the tramp steamer class to the larger passenger vessels where he meets all manner of individuals among the passengers and where he visits strange ports and becomes familiar with the various races and nationalities of the world. This is perhaps the greatest and most fascinating

The Marine Radio Operator—E. N. Pickerill, chief operator of the S.S. "Leviathan"

IT'S A GREAT GAME IF YOU FOLLOW THROUGH

Ten years ago a group of a few thousand men pushed on faithfully in their chosen work of radio. Some were ship operators, some were land operators, some were engineers, some construction men. Today, with few exceptions, these men have forged ahead steadily and are now holding key positions in the industry. Hard work, stick-to-itiveness, faith in the future of radio did it. In short these men followed through. Today the opportunities of radio are a thousandfold greater than they were ten years ago. The rapidly expanding art of broadcasting is responsible for this. There are a half dozen odd ways of breaking into The Game depending upon your individual taste and capability.

Mr. Boucheron is well qualified to write about this subject and to present the opportunities open today. He started as a "ham" amateur in 1907 and never lost faith in the great future of radio in spite of the early discouragement and unprofitable ventures of the pioneer days. Today he holds an important position within the rank and file of the Radio Corporation of America. This article is the first of a series describing the opportunities of radio. THE WIRELESS AGE plans to cover this important subject each month by a special article from the respective pens of several prominent men in the industry, men who will tell frankly and in uncolored language how any reader of THE WIRELESS AGE may enter one of the several branches mentioned in this paper.

It will interest some of our readers to know that this article was delivered by radio over WJZ on October 23, 1923. Over 200 letters were received from listeners asking for a copy of this talk. The interest displayed in this subject prompts the Editors to reprint it here in full for the benefit of readers of THE WIRELESS AGE.

THE EDITORS.

The Radio Scientist: Alfred N. Goldsmith, B.S., Ph.D, Fellow I.R.E., Director of Research Laboratory of the Radio Corporation of America

part of his career, for if I may use my own case as an illustration, I can say without the slightest hesitation, that some of the most ideal moments of my life were spent while a marine radio operator. Never shall I forget the thrill of anticipation, the feeling of accomplishment, the great hour of success when I stepped aboard my first vessel as a Marconi man.

The S.S. C——was a miserable tramp steamer of the fifth rate. She was laden to the Queen's mark with structural steel and a general cargo and was bound for the south side of Cuba. When she got out to sea she developed a bad list. The crew was the most nondescript crowd I ever saw even later after several years of experience. There were two Swedes, three beach combers, a college graduate who had long since lost all respectability because of drink, an exprize fighter who had seen better days, a clerk who had rebelled against a life behind a bookkeeper's desk in a dingy warehouse and a stowaway Cuban who was endeavoring to get back to his beloved country, the land of tomorrow—Lotus eaters all of them—fascinated by the spell of the Tropics. The captain was one of the hardest individuals I have ever met—"hard boiled" is the word. He feared neither God nor devil. The food was almost impossible, but to me this tramp steamer was a Leviathan. She was a seven-day wonder. I looked up at her aerials with an appraising eye and her radio shack seemed like a mecca for my dreams. The first trip on this steamer I lived in a daze. The sea was a revelation, tropical Cuba a Paradise. I shall never forget that first trip. It was wonderful.

I spent four years of this dream life and sailed on ships of various destinations and nationalities. Incidentally, I spent many hours in reading and in self-improvement, a point, by the way, which is often overlooked by the young ship operator. I saw new and strange parts and visited many foreign lands. It was not always ideal, however. There were storms; terrible, never to be forgotten storms; storms where even the captain had given up all hope of ever reaching land again. There were fires when the cargo had to be thrown overboard, jettisoned, it is called by sailors. There were shipwrecks and many other lesser catastrophes; nevertheless it was all very fascinating and enchanting.

It is simple enough to become a ship operator today. One goes to a school for training and after having secured a license, one waits for a ship assignment. This is possibly the easiest and most beneficial way of breaking into radio.

The other sub-division of commercial radio operating is that connected with land stations. In a few years the ship operator tires of the sea and wishes to settle down ashore. If he has become an expert radio operator, he is able to secure an assignment as a land station radio operator, working at one of the numerous coastal stations, the function of which is to communicate with ships at sea. Still another division of commercial radio operating is that of operator at a high-power trans-Atlantic radio station, such as those operated by the Radio Corporation of America. Employment of this sort does not necessarily mean that the operator must exile himself to some isolated section of the coast. Most land station telegraph operating is performed from a traffic center in a large city which controls the wireless station near the coast. Land station operating of this kind is practically the same as telegraph operating. It is a step up the ladder, however, because of increased responsibilities and greater opportunities. Later, the operator may become a minor traffic official or perform other executive work connected with this branch of radio.

Engineering

When one has a natural bent towards engineering and provided also that one has the technical preparation such as electrical engineering it is comparatively simple to become a radio engineer. Post graduate courses may be had at various universities. There are several in this country who have of recent years recognized radio as a science and who have made it part of

(*Continued on page* 53)

Radio Manufacturing: The Factory

Cooking Eggs — via Radio

Miss Anna Lewis Pierce Runs a Newspaper Kitchen

By Hortense Lee

Miss Anna Lewis Pierce

"PLEASE send egg recipes as mentioned in Wednesday's broadcast by lady cooking expert."

This was one of a heap of letters Miss Anna Lewis Pierce showed me, when I asked if women were good radio listeners. There were letters asking for egg recipes—answers to one lecture alone—from women all over New York State and New Jersey—from Ohio, Massachusetts, West Virginia, even Canada. It is these letters that make the radio audience real.

Anna Lewis Pierce, Director of the Tribune Institute, runs the only newspaper kitchen. Now, through radio, its tests of foods and kitchen appliances reach all the country, instead of just the New York area. Her kitchen, though not a very big one, is a delight. Kitchen cabinet, electric range, everything for bright, clean efficiency. There, an expert in home economics, a domestic science expert, a dietitian, chemist and electrical engineer all work together to test foods, recipes and household appliances. All are people of wide experience. Miss Pierce herself was for ten years in the Federal Bureau of Chemistry, where the food law is administered. Her talks are not only interesting, but authoritative; her recipes not only cooked, but eaten.

Many a man comes home these days to find tempting new dishes on the table, but his radio batteries much weakened. And many a man listens eagerly to the food talks, sometimes dictating a little note next morning, to please send his wife some of those recipes. One man wrote:

"New York Tribune:

"Dear Sir—Last evening while listening at the radio, I heard the address broadcasted by WJZ, of Annie Lewis Pierce. Subject, "Eggs for Breakfast, Lunch and Dinner." To me this talk was very instructive, and I was awfully sorry my wife was absent, as she has the memory for the family.

"At the conclusion of your talk I understood you to say anyone wishing the directions of preparing 'Eggs the Nineteen Ways,' to address as above. I would like very much to have the directions. Thanking you in advance, I am very truly,

"....."

"If any charge please advise."

But most of the letters are from women. A young bride who says she just started housekeeping, writes:

"I am fortunate enough to get plenty of strictly fresh eggs, and would like to try a few of the dishes you mention."

Another writes:

"I tried the scrambled eggs your way and they were elegant."

And so they read on:

"I was ill at that time and listened in while in bed."

"I enjoy your talks over the radio to the utmost. I know a great deal more about food than I did before I heard you."

"I like eggs very much, and I would like to know how to cook eggs in different ways."

"I really enjoy your discourses and make a point to chase up to my son's room, where he has his radio installed. It is a crystal set he made himself, and in my anxiety to get paper and pencil for one of your candy talks before Easter, I shook off the crystal, so lost out, I am sorry to say."

(*Continued on page* 25)

A corner in the busy kitchen where radio recipes are tried out

Woodrow Wilson Breaks Silence of Years

Thousands of Letters From All Parts of the Country Proclaim Enthusiastic Response to His Startling Declaration of Position on the Issue Carried With Him to Long Obscurity

Ellen Wilson McAdoo, on the left, Mary Faith McAdoo on the right, in Mr. McAdoo's suite in the Hotel Hamilton, Washington, D. C., listening-in to their grandfather's speech.

Unique in their position of "audience" they care little about the whys and wherefores of League Covenants or Foreign Relations. To them it is grandfather talking

WOODROW WILSON'S address, "The Significance of Armistice Day," was broadcast by WCAP in Washington, D. C., and WEAF in New York on November 10th.

He presented his appeal for America's participation in world affairs without compromise from his original position. Reminding us that Armistice Day should be a time of exaltation because of the recollections prompted, he deplores the fact that we turned our backs upon our associates and refused to bear any responsible part in the administration of peace, or the firm and permanent establishment of the results of war—won at so terrible a cost of life and treasure—only to withdraw into a sullen and selfish isolation which is deeply ignoble because manifestly cowardly and dishonorable.

In conclusion he declared that the only way in which we can worthily give proof of our appreciation of the high significance of Armistice Day is by resolving to put self-interest away and once more formulate and act upon the highest ideals and purposes of international policy.

And his closing words were: "Thus, and only thus, can we return to the true traditions of America."

The complete success of broadcasting Wilson's speech may be better appreciated from the fact that thousands of letters were received by WEAF from listeners-in all over the country expressing their delight not only with the address itself but as well with the clearness of reception, one amateur in Colorado claiming perfect results on his loud speaker.

The extent to which prominent speakers can reach millions of people vastly scattered over an immense territory was demonstrated as being most practicable by radio.

A few years ago Woodrow Wilson's address at best could have been heard by a comparatively small audience.

Cooking Eggs—via Radio

(*Continued from page 24*)

A husband and wife listened in together in one home, when Miss Pierce spoke of eighteen-cent veal. "See," said friend husband, "you can get cheaper meat." His wife wrote indignantly to Miss Pierce to ask where. Telling where, and telling how to make that cheaper meat appetizing and delicious is a big part of Miss Pierce's job. She says that the man wants to eat the expensive cuts, but to pay for the cheaper ones. And American women have yet to learn to make the most of the inexpensive meats.

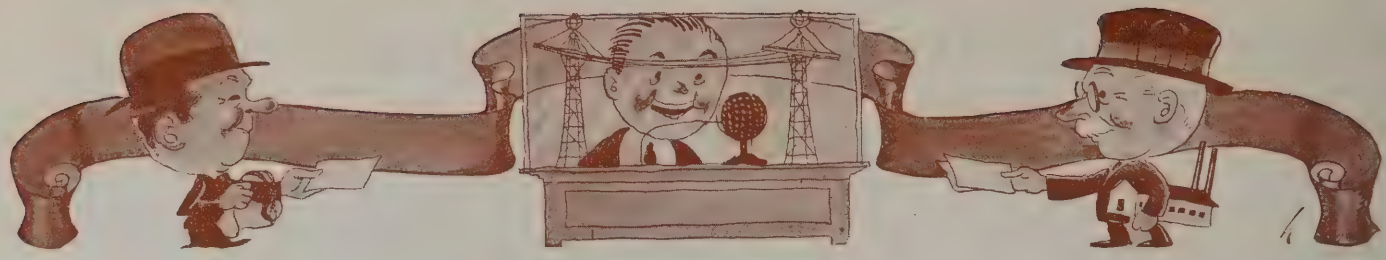
A man will go to a restaurant and pay a good price for a French "ragout." At home, he scorns the common American stew. The meat is the same. The difference is in simple matters of seasoning and preparation. More power to Miss Pierce and her pleasant radio voice, if she can turn our stews into tastier dishes.

"Foods for Health and Pleasure" is the general title of Miss Pierce's talks. Today, foods are our health remedies —not drugs. And much of the pleasure is in the preparing. Miss Pierce puts into the job of cooking all the interest and delight of an artist—and is trying to spread, through her talks, a sense of real enjoyment in cooking. Not only her experience, but her deep personal interest, gives her a sympathetic contact with the homes she is addressing. Many of the troubles of these homes are brought to her, and she finds much pleasure in helping to smooth them out.

Miss Pierce spends considerable time preparing her talks, and delivers them with much spirit to a very real audience, though only the little microphone appears before her. She has lectured on canned foods, on vegetables, on meats—each talk filled with practical, up-to-the-minute, ready-for-use ideas, with a bit of fun to make them good to listen to, and as much of personality as voice can carry through the air.

It is interesting to know how this woman lecturer feels about her radio audience. First, full of her subject, with a keen, sympathetic imagination, she feels the elation of talking to people everywhere; sees them listening interestedly—young, old—men, women —near, and miles away.

Then sometimes, half way through a talk, will come a sudden sense of utter flatness. How perfectly simple and foolish it seems, talking to a little instrument! Surely the people have tuned out or gone to bed, or switched to some other program. But the proof of this particular pudding is right in the dish on the table; many tables everywhere. And in the hundreds of letters that come in; some appreciative, some asking for more information, for recipes, for diet lists. These letters are the inspiration of the radio speaker. Keep them coming, if you want more lectures.



Footing the Broadcasting Bill

It's All Very Well to Turn the Dials and Pick Our Choice of Several Dozen Radio Programs, But How Long Is This Gratis-Free-for-Nothing Thing Going to Last?

By Austin C. Lescarboura
Managing Editor of The Scientific American

IF the automobile manufacturers supplied us with free gasoline, irrespective of what make of car we were using; if the phonograph manufacturers supplied us with free records for any make of phonograph; if the electric light and power companies supplied us with free current, because we had wired our homes; if the manufacturers of heating plants supplied us with free coal—if any of these things took place, then we would have a real parallel for radio broadcasting.

As it is, radio broadcasting is unique. There never was anything else like it; there is nothing like it today. And, most likely, there will be nothing quite like it in the future; for, truth to tell, the present state of affairs is economically unsound—and unfair.

The Old Story of the Early Bird

The story of how broadcasting came about is too well known and, as a matter of history, is too recent to require reiteration at this time. Suffice it to point out for the purpose of the following discussion that the early broadcasters were moved by one of three motives, and, in several instances, by all three. First, they broadcasted as a mere matter of radio telephone experimentation; in truth, that is how radio broadcasting came into being. Secondly, they broadcasted in order to put something in the air which the public would want and which could only be taken out by means of a radio receiving set, thus bringing about a popular demand for radio receiving equipment. Thirdly, they broadcasted because it afforded a new avenue of publicity at a time when other avenues were quite choked up. In the beginning there were very few broadcasters, to be sure, and these early birds certainly caught the figurative worms as a reward for their labors.

But these ideal conditions did not obtain for long. Presently, broadcasting became something more or less akin to an epidemic. Not only did receiving sets multiply by leaps and bounds, but more and more individuals and organizations suddenly discovered that they must broadcast some message or other to the public. From less than a dozen broadcasting stations, the number rose to 847, representing the high-water mark of the broadcasting fever, supplying good, bad and indifferent programs to well over two million receiving sets.

The pioneer broadcasters found themselves submerged by the avalanche of broadcasters. They no longer enjoyed that close and intimate contact with their listeners which marked the early days of the new art, because they now had to share their erstwhile exclusive audience with hundreds of other broadcasters. The early radio manufacturers who had found it profitable to broadcast as a means of stimulating radio sales, soon discovered, very much to their surprise, numerous newcomers pouring into the radio manufacturing field to take advantage of

A small tax on each vacuum tube

the business created through broadcasting. These newcomers, for the most part, have failed to contribute a single thing towards broadcasting or any other factor which has brought about and is maintaining the present radio industry. And then, as though to add insult to injury, they have proceeded to slash prices and to indulge in the most questionable business practices, while expecting the large radio manufacturers to continue broadcasting for the purpose of sustaining the radio industry. Queer psychology, this, and very much like biting the hand that feeds them. How long would these parasites last if the leading broadcasters were to quit in sheer disgust!

All for Publicity

As for the publicity possibilities of radio, these are as good as ever—better, if anything, because of the greater number of listeners. There is no better way of bringing a story to the attention of a large gathering of people than by radio broadcasting. Even the mere mention of the company doing the broadcasting has been considered ample reward, in numerous instances. It is thanks to this intangible something called publicity, therefore, that we are getting many of our excellent programs from organizations that are totally disinterested in the manufacture and sale of radio equipment.

Strangely enough, the little publicity that these unselfish broadcasters secure is often begrudged them. Every so often some bright individual solemnly rises to criticize the mention of the broadcaster's name, and to call attention to the alarming fact that said broadcaster is deriving real publicity from his broadcasting. Even newspaper men occasionally express their anxiety and displeasure in the matter of publishing the radio programs, with the customary mention of the call letters of the various broadcasters. Time was when these programs carried the name of the broadcaster as well as the call letters, but now the only mention made is that of the call letters and possibly the location of each station. Still, there are those who feel that the broadcasters are getting publicity—free advertising—from the mere publication of their call letters.

Now just for the fun of it, let us look into this question of free advertising. Instead of dealing with generalities, we will take a concrete case —the excellent WWJ station maintained by the *Detroit News*. The author was recently informed while visiting this station that it costs between $75,000 and $80,000 per year. This cost is due in large measure to the excellence of the WWJ programs. The WWJ orchestra alone, which is one of the very finest musical treats available through broadcasting, represents a considerable item in the total expenses. The first-class soloists who go to make the ensemble of this orchestra are paid handsomely for their frequent performances before the microphones. Then, too, the operating staff of this station is rather large.

Of course, WWJ has served as nothing else possibly could serve to spread the name and fame of the *Detroit News*. This progressive newspaper is performing a most commendable service for the Detroiters primarily, and for a wide circle of broadcast listeners. Indeed, the *Detroit News*, through its WWJ station, has become a real national institution, extending its activities far beyond its customary bounds. Whatever tangible value broadcasting may have for this enterprising newspaper must come through its efforts in the immediate vicinity of Detroit, however, while the longer reach of its radio arm must be considered as a most unselfish contribution to radio.

But what are the tangible results? What has been bought with the expenditure of $75,000 to $80,000? Merely publicity and the good will of the listeners. The results are so vague that they cannot be measured with any yard-stick. No direct commercial benefits are derived. The same sum of money could be employed to buy advertising space in newspapers and magazines throughout the country, if desired. Why, therefore, begrudge such publicity as WWJ may receive?

The High Cost of Broadcasting

And so it goes with other broadcasters. Aside from the original investment for the broadcasting equipment which may range from $50,000 to $100,000 for a high-power station, the weekly cost of a first-class program, including the operating expenses, is in the neighborhood of $2,000. Obviously, the small broadcasting stations, with infrequent and short programs, have lower expenses, some of them operating for as little as $250 per week. Please note that these operating costs are based on obtaining free talent, for the most part. As yet but few broadcast entertainers are being paid for their services, but the evil day will soon be upon us when many of them will insist on remuneration.

With the high costs on the one hand and the not altogether satisfactory rewards on the other, it is to be expected that many broadcasters are losing heart. Not a few have quit. From a total of 847 licenses granted by the Department of Commerce for broadcasting, the active number of broadcasters at this writing is 565, or a decrease of over 32 per cent. While on its very face such a drop might be considered a serious blow to the art, as a matter of cold fact it is a blessing in disguise. Most of the discontinued stations were of limited power and mediocre programs, and with their elimination it becomes possible for listeners, in their respective territories, to pick up the high-grade programs of the better stations. In fact, there are still far too many broadcasters in the air. Here is a case where quantity is a decided disadvantage. It makes for unnecessary interference. Better to have fifty first-class broadcasting stations, properly distributed so as to blanket the entire country, than over five hundred as at present. Hence there need be no weeping and gnashing of teeth over the present mortalities in radio broadcasting, just so long as the worth-while broadcasters stick to their lasts.

And here we are face to face with the ultimate problem. We must see to it that the real broadcasters remain with us. Just because they are supplying us with excellent programs day in and day out is no proof that all goes well with them. As a matter of cold fact, they are having a rough time of it. Talent is becoming increasingly rare—on the free basis, of course. time after time the announcers ask us to send in letters of appreciation and comment, in order that the talent may have something by way of applause. Yet how many of us take the trouble of writing just a few lines of appreciation? It is the only way, at present, in which we can repay the radio entertainers.

Listening-in like peeping through the knot-hole at a baseball game

Let us not be lulled into the belief that broadcasting is firmly established on the present basis. Let us not be led to believe that it is due us. Having paid nothing for this service, we are not entitled to demand such service. There are not a few among us who have felt for some time back that listening-in under the present arrangement was not unlike peeping through a knot-hole of the baseball field. There is a growing feeling among broadcast

(*Continued on page* 51)

BEFORE you have finished your perusal of this thorough-going discussion of the Broadcasting Problem by Mr. Lescarboura, who has grown up with the radio game since 1907 and brings to his task a preparation given by years of careful consideration of scientific and technical subjects—you will understand the character of material which THE WIRELESS AGE is endeavoring to present to its readers. Articles appearing from number to number in these pages will be found to be authoritative, instructive and satisfying.

A FEW OF THE CHOICE ARTICLES TO APPEAR IN JANUARY.

"How Radio Penetrated the Grand Canyon" is told by Colonel Birdseye, chief of a party of the United States Geological Survey. This article presents all the attraction which adventure and the unusual can contribute, and is moreover of wide scientific interest because of the successful reception of radiophone messages far below the surface of the globe. Think of getting baseball scores 5,000 feet down in this gigantic crevasse! An overturned boat occasioned newspaper reports that this expedition had been lost, but in spite of great obstacles and difficulty the party upset many prophecies and proved that DX was possible in the depths of the Grand Canyon.

"The Woman Listens In," by Hortense Lee, who contributed "Cooking Eggs" in this number, is a presentation of woman's reaction to radio. It will not only be of interest to every feminine reader but presents an angle of radio development most important to everyone in the radio industry.

In the January issue, THE WIRELESS AGE will feature a construction article on the application of a standard, reliable circuit to a control system that has been simplified almost beyond further reduction. Every radio enthusiast will take a keen interest in this new departure from the beaten track of experimenting. A dependable circuit has been rendered so simple of operation that even a child seeing this receiver for the first time could select programs as expertly as the designer. Watch for THE WIRELESS AGE Push-Button Receiver.

ORDER YOUR JANUARY WIRELESS AGE NOW

Christmas is Coming!

What better as an Xmas Gift to a Radio Fan than a subscription to THE WIRELESS AGE, the World's Foremost Radiophone Review?

Picking Up Broadcast Music

The Difficulties Encountered in Picking Up and Reproducing What Happens in Concert Hall or Broadcast Studio

By Alfred N. Goldsmith, B.S., Ph.D.
Fellow I. R. E.

THE human ear is a truly marvelous instrument. Few people recognize all the amazing feats which the ear and brain in combination can perform, and therefore how difficult is the task of the broadcast device which aims to hear and pick up for the listening radio audience exactly what is happening in a concert hall or studio.

To begin with, the ear hears a tremendous range of differently pitched sounds from the lowest notes to the highest. The deep boom of an organ pipe lies at one end of the gamut of notes which the listener prefers to have reproduced. At the other end of the long range lie the overtones of the violin and piccolo in all their interesting and tart shrillness, and the high pitched overtones which alone make the spoken consonants "s" and "f" sound natural. Actually the necessary frequencies range all the way from the ponderous tone of about 30 vibrations in a second to the piercing sound of 10,000 or more vibrations per second. If the lower frequencies are not correctly picked up the piano sounds "tinny," the baritone voice becomes a tenor, and the speaking voice, while understandable, sounds thin and unnatural. On the other hand, if the high frequencies are left out or partly lost, the violin sounds like a flute, orchestras give a jumbled and incomplete impression, and the voice, particularly of the feminine speaker, sounds muffled and indistinct.

The ear is also capable of hearing and appreciating a wide range of loudness in a sound. One can hear and understand a faint whisper and also an almost deafening shout. In broadcasting, so extreme a range of loudness is hardly required, yet it is necessary that the expression of a piece of music be preserved by subduing appropriately the softer parts, and accentuating fully the more forceful portions. It is not easy to find a suitable telephone transmitter and vacuum tube amplifier that will preserve the relative loudness of tones accurately. It becomes necessary to use vacuum tubes in somewhat extravagant fashion, most of the time working them far below the output they will give in other service in order to avoid distortion when loud notes are produced.

The artists must be correctly disposed before the microphone. The singer, carrying the melody, right before it; the violinist with the obbligato a trifle to one side, the piano farther away

Another characteristic of the human ear, or it may be, of the brain, is the ability to concentrate on a strain of melody or a particular part of a musical composition. This is particularly noticeable in connection with orchestral compositions. It is well known that the ear and mind can pick up and follow the melody played by the violins of an orchestra although the remainder of the orchestra is also contributing its full quota to the total of sound. To some extent this can be imitated in broadcasting by properly placing the transmitter so that the instrument carrying the melody is nearest to the transmitter and thus is accentuated in the resulting broadcast music. This, however, is always done at the risk of exaggerating this instrument unduly, or of suppressing other important instruments, and thus doing what is known as "throwing the orchestra out of balance." In fact, a good musical critic is a necessary element in every broadcasting station that has any pretensions to sending out really artistic productions.

Having mentioned the problems in picking up music for broadcasting, it may be desirable to give some of the various solutions for them which have been found. "The telephone transmitter which is used must be a very different device from the ordinary transmitter used on the usual telephone system." While the ordinary transmitter suffices for speech under comparatively uncritical conditions, it would not do at all for broadcasting. In the first place, it would be far too noisy. That is, "the average transmitter produces a certain amount of hiss and crackle which would be intolerable in high-grade broadcasting." When carbon grain transmitters are used, they have to employ a special grade of carbon and to use very small currents so that they will produce a minimum of such objectionable noise. Otherwise the desired velvety silence when the artists are not singing will be missing, and the audience will be distracted and annoyed by the hiss of the transmitter.

A second objection to ordinary telephone transmitters is that they exaggerate certain frequencies of the voice or music very markedly because the vibrating diaphragm or sheet of the telephone transmitter responds most vigorously, or "resonates," to certain frequencies or pitches. This is not acceptable in sending out music. Particularly dangerous would be the effect of such partiality for certain notes if the transmitters were used for sending out an orchestral selection. Some instruments would be partly suppressed

and others exaggerated, thus spoiling the effect. So that it becomes necessary to use a telephone transmitter which has a diaphragm which responds as evenly as possibly to notes of all pitches. One way of doing this is to use a thin and powerfully stretched diaphragm of steel or some other strong material which will respond equally to all usual tones. Another way is to use the so-called "glow microphone," where the vibrating element is a small column of glowing gas through which a small electric current is passing. Yet other methods are available, but most of them not particularly simple.

The telephone transmitter used for pick-up in the studio has to be suitably mounted and wired up to the rest of the equipment. One of the photographs accompanying this article is the pick-up transmitter at station "WRC" of the Radio Corporation of America, located at Washington, D. C., and familiarly known to listeners as "The Voice of the Capital." Standing before it is Assistant Secretary of the U. S. Navy, Colonel Theodore Roosevelt and Major General John L. Hines, Deputy Chief of Staff of the U. S. Army. The transmitters—for there are two inside the casing—are enclosed in a casing which carries a design that is highly symbolic of broadcasting. It shows the harp—the emblem of music from earliest times, and the spark—which has always remained our classical symbol for radio. Although the spark is really not used in radio telephone stations, yet the harp-and-spark design is an appropriate symbol for "music carried by radio." This particular design is due to Mr. Edward Field Sanford, Jr., one of America's leading sculptors and also, incidentally a most ardent broadcast listener.

Colonel Theodore Roosevelt, Assistant Secretary of the Navy, and Major-General John L. Hines, Deputy Chief of Staff of the Army, before the microphone of WRC, "The Voice of the Capital"

Controlling the quality of tone

The amount of power which it is possible to get from these high-grade telephone transmitters is nearly always very small, and it becomes necessary to amplify it by means of a powerful amplifier. This amplifier must also be free from noise-producing tendencies, and must amplify notes of all pitches equally. Both these requirements are very difficult to meet. Either resistance-coupled amplifiers have to be used, or else the greatest care has to be taken in the design of the special transformers used in a transformer-coupled amplifier for this work. Ordinary amplifiers would not serve at all, as is sometimes evident when listening to the "music" emanating from a badly designed broadcasting station. A good idea of the elaborate nature of a suitably designed amplifier is obtained from the photograph accompanying this article which shows the control room amplifier of Broadcast Central, Stations WJY and WJZ of the Radio Corporation of America at Aeolian Hall, New York City. This amplifier is really two amplifiers, one at the top of the case, and the other at the bottom. Special relays permit either amplifier to be used at will so that there is always a spare amplifier available in case a tube burns out or some other defect develops in one of the amplifiers. The control room engineering attendant at these amplifiers is perforce chained to his post during the entire performance listening to every note that goes out through special "monitoring sets" and maintaining loudness and quality of the music by the suitable controls which are provided. He also has a number of special colored signaling lamps before him on the control room amplifier so that he knows just what is going on in the studio and whether the transmitter which he controls is actually "on the air"—that is, transmitting—or not.

Clearly carelessness and simplicity have no place in either the design or the supervision of the pick-up transmitter and control room amplifier of a satisfactory broadcasting station. The broadcast listener would do well when he is especially pleased by the clarity and excellence of an evening's performance to remember something of what has been done by "brain and brawn" in reproducing in his home the intricate and yet delightful melodies and sounds which make up the broadcast program.

Radio Making Sport Interest Nation Wide

We Can Participate in the Event When it Transpires. No Need to Wait for Cold News

By Raymond Francis Yates

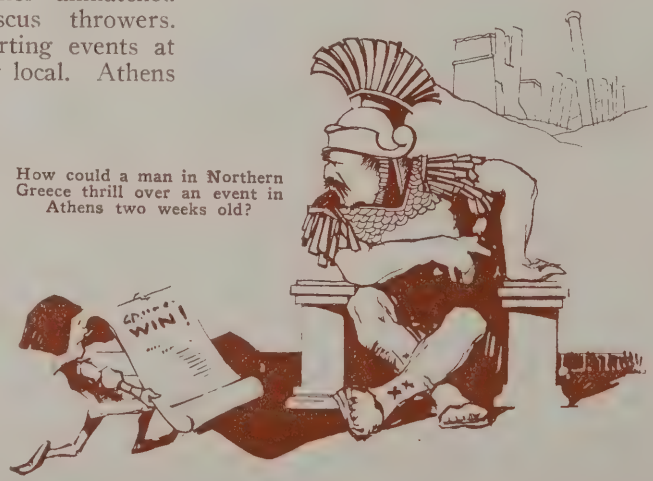
THOSE who know the technical, economical and commercial limitations of radio have always objected to the manner in which unseasoned radio editors are inclined to speculate. Some of our more daring and imaginative newspaper scribes have had it doing everything from curing cancer to felling airplanes. It is a jack-of-all-trades, capable of turning the world topsy-turvy.

Radio is a tremendous thing and it is easy for one to under-estimate its importance and the far-reaching effect that it will have upon the lives of men. The writer mentions these things just to warn the reader that he is not off on one of these highly speculative tangents telling how radio is going to do this and that with the avowed purpose of shocking someone's imagination. He is not going to tell what radio can do but what it is doing.

If there is one thing upon which radio has made an unmistakable impression it is sport. Indeed a careful observer will agree that radio has proved itself a needed stimulant, for a new wave of enthusiasm is passing over the entire country. This is not a phenomenon, but the natural, inevitable outcome of the broadcasting of sport events.

Before the writer goes further with his argument, he would first like to prove to the reader, beyond the question of a doubt, that national interest in any sport is simply a matter of communication. Offhand this may sound like a wild statement, unfounded in fact, but let us go back to the time of ancient Greece with her unmatched marathoners and discus throwers. Practically all the sporting events at that time were entirely local. Athens had its meets as well as other cities. But there was no rousing national enthusiasm or keen interest in any one particular match. How could there be when news traveled so slowly? What enthusiasm could a man in northern Greece have for an event in Athens when it took two weeks for the outcome to reach his ears? Each particular community, where news could travel by word of mouth with a fair speed, could, of course, raise itself to a normal pitch of interest. But, in any case, there was not that great national fever that can be worked up today. Take our world's series, for instance, the broadcasting of which is still fresh in our minds. The baseball fans of Buffalo, Chicago or Philadelphia were just as keen about the outcome as a man in the Bronx whose apartment window overlooked the Stadium. The reason is simple enough to understand. The men in Buffalo, Chicago and Philadelphia have kept themselves informed regarding the vying teams throughout the entire year. They know the batting average, the errors and the general record of each player. They read it in the newspaper every night or they get it over the radio.

The World's Series attendance multiplied with the advent of Radio



How could a man in Northern Greece thrill over an event in Athens two weeks old?

When Benjamin Franklin was Postmaster General of the United States, it took over two weeks for a communication to reach Buffalo. Compare two weeks with two minutes and you can easily account for the enthusiasm of the Buffalo fan. It keeps his imagination fresh and alive because he knows that the event has just happened. It isn't stale; it isn't a thing of yesterday or last week, it is fresh and stimulating. Would the enthusiasm of any fan survive to thrill him if he had to wait two or three weeks to hear of the outcome of a sporting event? It is the rapid spreading of news that has given to America that great and healthy love of sport, that has placed her in the front rank as a sport-loving nation.

We do not have to go back very far in history to discover the period during which our sporting fever began to grow and thrive. Before the telegraph came there were no Bob Fitzsimmonses, Babe Ruths or Bill Tildens. If there was a big event in Buffalo, the man in Frisco had no interest in it for the thing was history by the time he got word of it. Each event was isolated to the community in which it took place.

When clicking telegraph instruments began to feed hungry newspaper columns with red hot news, there was born in the national heart an undying love for the thrill that comes through the contest of human skill and power, whether it be fighting, sculling or automobile racing. Before Morse's telegraph system came into wide use sports were practically dead in this country.

Ask any real old man to name a few of the champions of his early youth. Indeed, sport was dead until 1850. John L. Sullivan owes his fame to the noisy little telegraph instruments that brought the news of his prowess to city and hamlet of the United States.

Before the Atlantic cables were installed, what did we care about the fast English racing horses or the outcome of boxing matches? If we can have the details the same day the event happens the thing takes on an altogether different aspect, especially if preceding news items have kept us "keyed up." If we had to wait for the *Leviathan* to bring the news what a drop the barometer of sports would take!

Sports Now Brought to Your Easy Chair

Is it not natural therefore that radio should bring about a great revival of love for sport? Here is an instrumentality that so effectively annihilates space and time that it permits us to move our easy chairs to the noisy grand stand of the football and baseball fields, the race tracks or the spectators' boats of the regatta. No event, whether taking place in the clouds or the English Channel is out of reach of the radio. The extent of the usefulness of radio would be appreciated by wondering what would happen if we had to stretch wires to these points and connect every home to the main line by their use.

If the growth and support of sporting has been brought about through communication, we have every right in the world to expect that radio will bring with it a revival that will end one knows not where. It has already created a stir. People who never before took an interest in sports have found them to be exhilarating. They did not go over to the baseball field to get this enthusiasm, it was brought into their homes through the loud speaker or telephones. They tasted a little bit of it, liked it, and had more. Radio was the first thing that actually ever brought them into contact with clean sport. Many of them never knew what they had been missing until the voice in the loud speaker brought to them a mind picture of a great contest; brought to them the living voices and actions of the players as well as the fans. Thousands awoke to find that they had discovered a new form of recreation. Gentle, home-loving women who thought they never could be interested in a prize fight found themselves standing on chairs during the excitement of the Dempsey-Firpo battle. Business men who never liked baseball listened to the report of one over the radio and next day found them for the first time lured to the grand stand. The conversion was wholesale, for radio is now installed in probably three million homes, and any converting that it does is usually done with a vengeance and it is necessary to deal with appalling numbers. If only five per cent. of the listeners were made better sport lovers the calculation brings us to a figure of two hundred thousand. The writer knows of a dozen and one people who had aroused in them a desire to see either a prize fight, baseball or football game. Before radio they were phlegmatic and uninterested.

Gentle, home-loving women stood on chairs during the Dempsey-Firpo fight

A few years ago there was plenty of room left in the grand stand at the world's series, although the Polo Grounds Stadium was not as large as it is today by some few thousand seating capacity.

Radio Has Increased Gate Receipts

Last year the world's series was broadcasted by radio. This year, both the Polo Grounds Stadium and the Yankee Stadium, which by the way is the largest in the world with a seating capacity of 62,000 souls, were filled to overflowing at every game, piling the gate receipts up to a point well over a million dollars and only six games were played! Never before had so much money been taken in at a world's series. Never before was there such a nation-wide interest in the games. Is it not reasonable to conclude that radio has been responsible for this new support?

The American Baseball Writers' Association objected to the broadcasting of the world's series on the grounds that it would interfere with the sale of the evening newspapers that carried a story of the games. Fortunately the wise and able Judge Landis overruled their objection. Did it interfere with the sale of papers? It did not. It helped the sale by tens of thousands, for the fans who had heard White and McNamee describe the action, play by play, in the most vivid fashion, turned off their loud speakers and hied them out to buy a paper to see how accurately the broadcasters had described the games and also to get details of the games not possible to report over the radio. Practically everyone who listened and who felt the excitement had this desire to buy a newspaper and to read again the actions that took place. Every newspaper circulation man in New York City will disclaim that radio had anything but a good influence upon the distribution of newspapers carrying sporting pages. Here again we find radio building up in a constructive way.

What holds true of baseball holds true of fighting. Half again as many seats could have been sold for the Dempsey - Firpo fight, and what holds true of this also holds true of football.

Greater Interest in Sports Means Health

There is another angle to this radio sport situation. It has to do with the health and well-being of the country at large. Now that everyone with a radio receiver is exposed to the thrill that sport brings, is it not reasonable to believe that we will have more actual participants in sport? For instance, a man listens to the account of an exciting tennis match. He may decide at the time that tennis is just the game he would like and next week we will probably find him on the neighboring tennis court trying his best to learn all the tricks of the game. If he is young, he may succumb to the lure of baseball, to running, boating or a dozen other sports. This is happening every day and will continue to happen. Women, too, will be led to the tennis court, golf links or swimming pool.

This wholesale conversion to outdoor sports is bound to have a beneficial effect on our national health and consequently on morality statistics. It is just another instance of the way in which radio is bringing with it undreamed of benefits. The radio horn is a potential spreader of good.

Every sporting event of any consequence that is broadcasted is now carried to an amphitheatre large enough to pale the great Coliseum of the Romans into insignificance. Its seating capacity is limited only to the United States, and out of the millions who are seated in it we can expect to win many thousands over to be not only lovers of sport, but participants as well.

The glow of vacuum tubes in thousands upon thousands of homes, accord former Premier of Great Britain a farewell reception of proportions never before enjoyed by a guest of the nation

Radio's Torchlight Parade to Lloyd George

By Edgar H. Felix

A MILLION LISTENERS ← New York Washington Providence ← One Little Switchboard ← Lloyd George Makes a Notable Farewell Speech to the Country

THE uproarious welcome to Lloyd George as he stepped on the platform of the Metropolitan Opera House in New York was an expression of cordial feeling which only an American audience can accord a world hero!

But a magic eye could have perceived a greater reception—the glow of a million expectant vacuum tubes—which exceeded in significance the cheers of ten thousand lusty throats. The little beacons of the ether awaited America's guest in hundreds of thousands of homes and augmented the army of listeners to Lloyd George's momentous speech of November 2nd by hundreds of thousands. If these glowing ether sentinels could have passed in review before the ex-Premier's eye he would have seen a torch light parade which has never been equaled in the annals of time.

Here was a reception to the mighty leader who directed the destinies of the world's greatest empire through the world's greatest war which, though unseen, was none the less a great step in promoting international intimacy. Radio broadcasting made possible an acquaintance with one of the greatest characters of the age which months of speaking could not have accomplished. The use of lines in connection with several broadcasting stations made this event of even still greater scope and significance.

Three scattered stations, WEAF in New York, WCAP in Washington, D. C., and WJAR in Providence, R. I., enabled the owner of even the simplest of radio sets to pick up Lloyd George's speech almost anywhere along the Eastern third of the United States.

The microphones on the speaker's platform served as the connecting link with an extensive lay-out of special telephone equipment. The tiny microphone currents which it controlled were amplified through a special speech input panel at the Opera House which supplied telephone lines leading to WEAF's plant department.

We will not consider technical details more than to point out its special functions. Before it may be used in connection with radio broadcasting a telephone line must be especially treated to adapt it for the purpose. The output of these lines is subjected to immense amplification by the radio transmitter before it is broadcast into the ether. Any extraneous noise or distortion even though completely inaudible to one listening on an ordinary telephone line becomes objectionable when broadcast in its amplified form. To accomplish a degree of quality required for broadcasting, a surprisingly large array of adjustable inductances, capacities, resistances, filters and what not, must be manipulated by skilled engineers. Preparations involving extended tests contribute in no small degree to the quality of what is ultimately sent into the ether.

This is the announcer's switchboard at WEAF, through which programs coming over land line from various other stations may be put on the air in any or all of the Bell System Broadcast Stations. Conversely, programs in any of the associated Bell Stations may be routed to any of the other stations in the system.

Who can say that this is not the forerunner of a super-switchboard of the future, that will distribute programs to broadcasting stations all over the country!

The nerve center of WEAF and its associated stations is the special switchboard installed in the announcer's booth. This board serves as an exchange for both incoming and outgoing programs and provides for separate or simultaneous announcements through various stations connected with it. Cam switches on this board control all circuits, both incoming and outgoing.

Special telephone circuits lead from the switchboard at 195 Broadway to the terminus of the long distance telephone lines at 24 Walker Street. All

long distance telephone circuits centered about New York terminate in the Walker Street Building and the transmitting apparatus of Station WEAF is also installed there, including lines connecting with broadcasting Station WCAP of the Chesapeake and Potomac Telephone Company in Washington, D. C., and to the Outlet Company's Station WJAR in Providence, R. I.

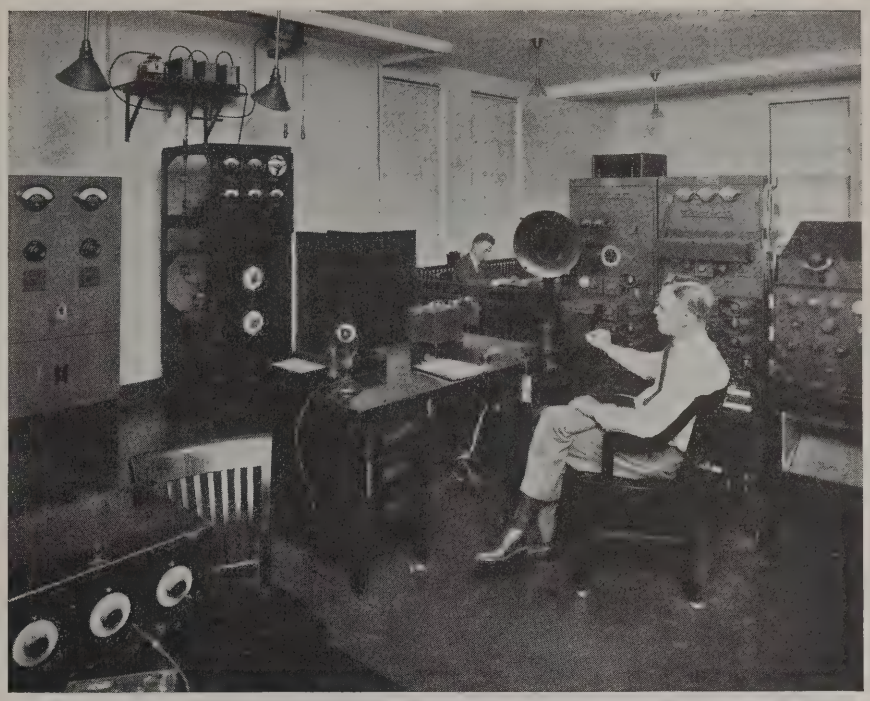
For special events, other stations have been linked by special circuits, including WGY, General Electric Company at Schenectady; WNAC, Sheppard Stores, Boston, Mass.; WMAF, Colonel E. H. R. Green's Station at South Dartmouth, Mass.; KDKA and KYW, the Westinghouse Electric and Manufacturing Company's station at Pittsburgh, Pa., and Chicago, Ill., respectively.

Connected with the nerve center of the station are incoming circuits some of which are temporary and others permanent. For instance, the installation at the Metropolitan Opera House was a temporary one, but other locations are used on a regular schedule as occasional features of WEAF's program. Most noted of these are the Capitol Theatre installations, the Skinner Organ Company and the Bedford Branch Y. M. C. A. Each of the features thus made available to the radio audience is appreciated as expressed in thousands of letters each month and it is only by the combination of wire lines in connection with radio broadcasting that the greatest features are made possible to the radio audience.

Temporary input circuits through WEAF's plant department have been employed from many points, including Washington, D. C., Chicago, Ill., Alexandria, Va., Cambridge, Mass., New Haven, Conn., Baltimore, Md., St. Louis Mo., and Kansas City, Mo.

The use of telephone lines in connection with radio broadcasting has been, from the technical standpoint, highly successful. Expert judges of speech and musical quality have declared that events picked up from distant points and supplied several stations, do not suffer from objectionable distortion. Almost any listener on the Atlantic Seaboard can determine this for himself by comparing the quality of the reception of the Capitol Theatre program which is sent simultaneously each Sunday evening through WCAP and WJAR as well as WEAF.

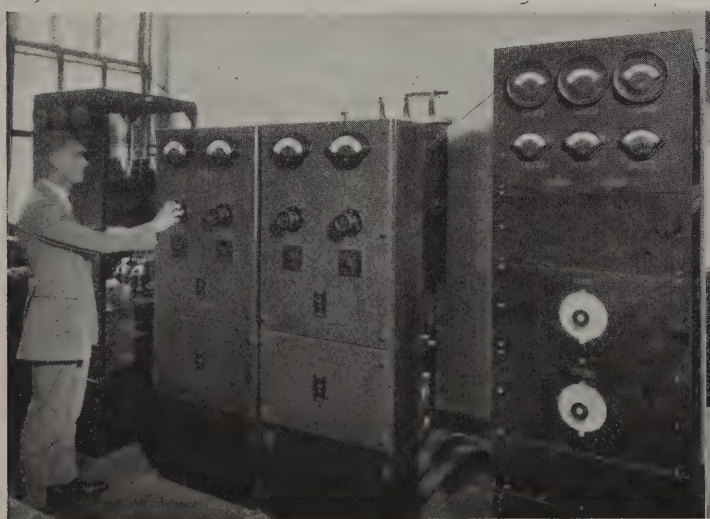
The public demand for important speakers and events can never be met entirely by studio events. Nor can a standard of program necessary to satisfy the demands of radio listeners centering about stations not located in very large cities be met by the broadcasting of local talent. The exchange of radio programs through WEAF's special exchange, as used on the occasion of Lloyd George's speech, is, therefore, likely to become of constantly increasing importance.



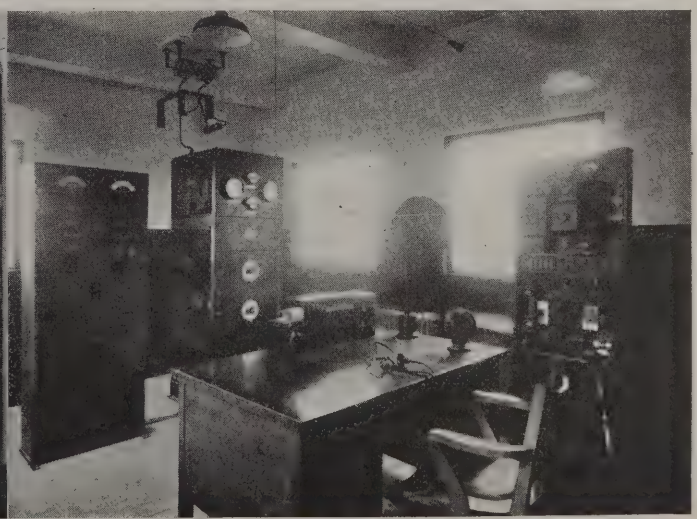
WASHINGTON, D. C.
Control room of WCAP, the Chesapeake & Potomac Telephone Company

French Interested in American Apparatus

RADIO fans in the Lille District of France are manifesting interest in American-made equipment, Consul Squire reported recently, pointing out that as permits for receiving sets may now be obtained from the government, there is no reason why the use of radio should not increase steadily. Broadcasting from Paris, London, Cardiff and Glasgow can be heard in Lille regularly, he adds, the Paris concerts coming in on 1,000 to 1,500 meters and the British stations on 200 meters.



NEW YORK CITY
Transmitting apparatus of WEAF, the American Telegraph and Telephone Company



PROVIDENCE, R. I.
Transmitting and control room of WJAR, the Outlet Company

RADIO provides means for affording national participation in events of national interest

Filling the Air With Tribute

Roosevelt Memorial Day

By Stuart Hyde Hawkins

Speakers whose tributes to Roosevelt were broadcast from WJZ October 27. Standing: W. J. Hays, former secretary to President Roosevelt; General J. G. Harbord, President of the Radio Corporation of America. Seated: Ex-Senator Calder of New York; Judge McAdoo, Magistrate of the City of New York

And all the winds that blow
Must bear his praises sung
By an adoring people so that they
On farthest hills and over widest seas
Must hear of him and stop to pause
and listen. —Parclenus.

WHEN the ancient Romans heard these words, it is not probable that they conjured a vision of radio broadcasting as we know it today; the words were merely intended to express the depth of a love which exceeded the descriptive power of human adjectives. Yet today, taken literally, those same words describe with utmost perfection the degree of love of a nation for a man which also exceeds the scope of linguistic vocabulary. For the first time in history the ether of half the world has been actually filled with the name and praises of a nation's favorite; never before has the sentiment of a people for a departed leader received the fulness of expression which was accorded that for one of the greatest Americans of all time on October 27th; other leaders of this and other countries may, and in all probability have been as loved, admired, and revered by their people as has Theodore Roosevelt, but science has never until now supplied the means of expressing that sentiment so fittingly. Roosevelt Memorial Day found broadcasting stations throughout the country sending tribute after tribute into the air, until at one time the ether from the coast of France to the middle of the Pacific, from northern Canada to southern Mexico, was filled with eulogies and commemorative ceremonies.

One of the most interesting and inspiring ceremonies I have ever witnessed was the presentation of the Roosevelt Memorial program to the hundreds of thousands of radio listeners from station WJZ in New York City. It was my particular good fortune to be present at that station on the evening of October 27th; good fortune because the inner workings of a radio broadcasting studio are always interesting, and particular because to this station, one of the greatest in the country, was allotted the longest and most extensive program of the many which composed the transcontinental radio tribute. A musical program by the band of the U.S.S. Colorado, the latest and greatest dreadnaught of that navy in which Roosevelt took such pride and interest, and addresses by four of his closest friends, were combined to form one of the most expressive anniversary ceremonials which man could give.

When I entered, the band was already seated in the large studio, arranged in fan-shaped formation radiating from a mahogany cylinder which stood high on a severely plain shaft near one end of the room. In an adjoining room a man was seated before a table on which reposed in solitary state a black disc-like object, into which he spoke, in that clear calm voice radio listeners know so well. "In honor of the late Theodore Roosevelt, whose birthday anniversary is being commemorated throughout the country—" and so to a short, clear, simple and dignified explanation of the nation-wide radio tribute in which WJZ was about to participate, ran the voice. A movement of the wrist, the almost inaudible click of a switch, accompanied by a nod to the leader of the band, and the opening strains of "Anchors Aweigh," one of Roosevelt's favorite marches, filled the studio. And over me swept the realization that the studio was the most negligible part of the vast space those notes were filling; unseen, apparently unappreciated, that band was playing to the greatest audience in the world; the march which Roosevelt so liked was being heard in thousands of homes by hundreds of thousands of the people whom he had so enjoyed serving.

In a soft-toned, dimly-lighted reception room, isolated from the studio by sound-proof walls, sat four men, listening with varying emotions to the reproduction of that march which issued from a cabinet receiving set in one corner. Every one of them had at some time heard that march in the company of Theodore Roosevelt, for each had been a close personal friend

of the former President. Walter J. Hays, former Senator Calder of New York, Judge McAdoo, and General J. G. Harbord were there to describe to the listening populace the life of "T. R." as they had known him. As the band neared the end of the march Mr. Hays rose quietly and walked to the table where the announcer sat. The moment the last note of "Anchors Aweigh" had died the announcement that "Walter J. Hays, former Secretary to President Roosevelt, will be the first speaker," and a few scant seconds later Mr. Hays was telling the listeners-in of his own contact with his former chief. In the low, serious, conversational tone, the talk seemed infinitely more personal, more sincere, than do the oratorical eulogies so often delivered by speakers in large meetings. The simplicity and unaffectedness of the talk, impossible of attainment through any medium other than radio, solemnized the occasion to an inexpressible degree.

Birthplace of Theodore Roosevelt in New York City, dedicated as a National Shrine, Oct. 27. Crowds outside the house could hear the dedicatory exercises through loud-speakers

Quietly, calmly, with no stir or confusion, the program was carried out with one number by the naval band between each of the four addresses. Mr. Hays, Judge McAdoo, Senator Calder, and General Harbord—each speaker took his place before the microphone, each one described, in the dignified convincing manner which radio makes possible, his memories of Theodore Roosevelt, telling in the strictest sense of the word just what Roosevelt had done, what he had stood for, and what manner of man he was. From Mr. Hays the radio audience heard the story of "T. R." as the First Executive of the Land, for it was in that capacity that Mr. Hays came into daily and intimate contact with him; from Judge McAdoo came the description of Roosevelt as the insuppressible New York politician, overcoming the obstacles placed in his way by the "interests"; Senator Calder, one of his closest friends, told of Roosevelt as the rebuilder of the navy; and General J. G. Harbord, himself a former army commander of long experience, told of Roosevelt as a soldier, the Roosevelt the popular imagination pictures most often.

The beauty of the tributes lay in their sincerity; the intricacies of vacuum tubes and amplifiers enabled those men to portray Roosevelt as faithfully as they would have done in reminiscing together in a corner of a club. The utter lack of dramatization, the ordinary conversationalism of the speeches, was more impressive, more splendid, than hours of platform oratory. Straight from their hearts they spoke, conjuring up as much for their own benefit as for that of the invisible audience the memories of their common friend, talking as men talk when effect and applause are forgotten. No audience was there to spur them to bursts of dramatism; apparently—so it seemed there in the studios—they were unheard. And in the security of the seeming seclusion they could forget themselves and remember Theodore Roosevelt as they could have done in no other way. Genuine wholehearted tribute it was; and that the vast number of Americans who were listening in could hear such a memorial is reason enough, to my mind, for the existence of radio broadcasting.

The last number by the band was "on the air" when the four men left; they had expressed a little of what T. R. meant to them and to the country; they had said it well, and in dignified simplicity commensurate with the spirit of the entire program. They said goodby to each other and to the studio personnel and left. To me, the entire affair seemed to personify the man whom it honored. By the great and yet fundamentally simple medium of radio, in an unpretentious and yet forceful way, the sincerest type of eulogy had been delivered to a great audience; and certainly Roosevelt was great, was unpretentious, was forceful, and was sincere.

Prize Contest Announcement

WHY I BECAME A RADIO FAN

YOU have a chance until December 31st, 1923, to win one of the *five valuable prizes* offered in the WIRELESS AGE contest.

Sit down NOW and in 100 words or less tell us just why *you* became a fan—how the one incident that changed "radio" from an impersonal subject to one of the most important of your pastimes came about. *Why* did you become a fan?

THE WIRELESS AGE offers five prizes for the five best letters (of 100 words or less) on this subject.

First Prize, $10.00; Second Prize, $5.00; Third, Fourth and Fifth Prizes, One year's subscription to THE WIRELESS AGE.

Prize contest conditions—Letters on the subject announced will be judged by the Editors of the WIRELESS AGE with particular attention to the story value and interest in the circumstances described. Ability to tell the story well will also be considered, of course. The contest is open to everyone and entries will be accepted up to and including December 31, 1923. Prize winning letters will appear in the February, 1924, issue, and in addition to the prizes mentioned, regular space rates will be paid to the prize winners for the space given their letters in the February, 1924, issue.

Peeps into Broadcast Stations

A Bank Becomes a Broadcaster

Mr. Elmer G. Johnson, announcer of WJAX

THE Union Trust Company of Cleveland has inaugurated an interesting experiment, along the lines of adapting broadcasting to commercial use. It has established a station of its own from which to send out financial and commodity reports. Appreciating the value of adding entertainment to its programs, it is gaining for itself a well-deserved popularity.

October 23, it broadcast the address of Lloyd George, former Premier of Great Britain, delivered upon the occasion of the laying of the cornerstone of the new Main Building of the Cleveland Public Library. Powerful receiving sets, with loud speakers, were set up in the school auditoriums and classes were suspended while the students gathered to hear the words of the famous statesman.

Countless thousands beside the school children heard Lloyd George from WJAX as was attested by the many telephone calls and telegrams from many different states and from Canada.

Union Trust Company's project of a radio financial news service to the farmers and business people is unique and promising.

Studio of WJAX, the Union Trust Company, Cleveland, Ohio

Amrad WGI

FROM its lofty tower close by the route of Paul Revere's historic ride, the Amrad station was among the very early pioneers in broadcasting speech and music across the land.

The tower that nearly wrecked the Montreal Express. 320-foot tower of WGI

"Sowing seeds in the air" seemed in those early days of radio but the odd dreams of a fanciful visionary. How well these "seeds" took root is evidenced by the remarkable growth of the radio industry.

It was in the summer of 1915 that Amrad WGI, was first erected at Medford Hillside, Mass., due to the persistence and foresight of Harold J. Power, one of the great leaders in the radio art. These were the days before present-day broadcasting licenses were issued by the government. WGI was then designated as 1XE, an experimental station call assigned to the American Radio and Research Cor-

poration. It was during 1916 and 1917 that the newspapers of New England frequently printed stories about radio music and speech being heard in isolated communities and by ships at sea—stories which seemed almost incredible to the reading public.

In connection with the erection of the tower over eight years ago, there is an interesting story:

On a Saturday noon, the workmen erecting the tower, the first and highest of its kind, had almost finished their job. However, the supporting guide wires were not in place. This almost criminal negligence on the part of the workmen nearly resulted in a serious fatality. A gentle breeze sprang up, rocking from side to side the 320 foot perpendicular structure which was entirely unsupported. An extra draft, and over the tower toppled, falling across the trolley wires of an adjacent thoroughfare, and also across the fairway of the Boston & Maine Railroad. The Montreal Express was approaching at 60 miles an hour, but fortunately the engineer saw the tower falling, and was able to bring the train to a standstill by applying the emergency without crashing into the débris.

At once work was started to reerect the tower, but this was delayed due to a protest from the trolley company, railroad, and nearby residents, who feared the tower as a mysterious menace to public safety. The proposition even went before the State Commissioners, who fortunately were broad-gauged enough to appreciate the far-reaching possibilities of radio broadcasting and to recognize that the engineering construction of the tower was basically sound. Their judgment has been adequately justified by the intervening years.

Herbert Dwight Miller, the announcer of WGI, has a keen sense of humor

Of course, the early broadcasting efforts were periodic, first bi-monthly and then weekly, and then twice a week. Over two years ago, May 20, 1921, regular daily and nightly broadcasting was scheduled, and has continued without intermission ever since. The first Director of Broadcasting was H. M. Taylor. The first studio was a comparatively primitive affair in marked contrast to the richly furnished and conveniently arranged studios of today. Three times has the studio been entirely remodeled to keep pace with the increasing improvements of the broadcasting art, in order to keep this oldest broadcasting station on a par with the best of the recent stations.

While using comparatively low power, 100 watts, the station has been heard from coast to coast in Canada, and the West Indies. Noted persons of this country and Europe have been attracted to the station.

"H. D. M.," the genial announcer of WGI, has the title of "Professor" or something like that, out of Tufts College. Herbert Dwight Miller, Instructor of English, is the popular Medford announcer.

"Artists often ask us what they are to sing in," said Mr. Miller. "We tell them to just go ahead and sing, the microphone will pick up the voice, but some of them demand to see it, so we have to take off the lamp-shade and then they are all right. They explain that they wish to see the thing so that they can concentrate on something. You know it is a new sensation singing or playing to an invisible audience. There is no applause—nothing.

"Announcing has its difficulties. I remember one night I was announcing a recitation of 'The Raven' by Pie. Imagine the laugh that went up for several thousand miles when I made that slip.

"One night we had a woman singer who insisted there should be something or other to help send out her voice. She didn't have much confidence in the little microphone. Finally, to please her, I said we would have to get out our resonator. I did not have the slightest idea what a resonator was, but we found a drawing board about

OTTO E. KRUEGER

Many people have heard Otto Krueger introduced to the radio audience as the conductor of the Detroit News Orchestra, but few have ever seen him, so here he is. A sparkling personality, brilliant musician and a good natured "plump" man. The orchestra he leads was organized in May, 1922, to play for WWJ auditors

JEAN GOLDKETTE'S ORCHESTRA

This is one of the recent additions to WWJ's list of music every Wednesday and Friday noon and every Thursday at 10 p. m. Their music is broadcast from the Graystone Ballroom, Detroit's leading dance hall

the size of a bread board, placed it on the floor, told her that was the resonator, and to go ahead. This did the trick, and everybody was happy.

"A while back WGI used to send out setting-up exercises every morning about 7:30. The fellow who ran the series used to get lots of letters from enthusiasts who said they did the exercises, but one day a listener wrote in stating that 'While you read off those exercises I lie in bed and listen to them, refusing to get up.' Our instructor wrote back, 'That's nothing, I send them lying in bed myself.' (Perhaps they were both lying.)"

Herbert Dwight Miller was born in Saranac Lake, N. Y., 27 years ago. He is a graduate of Dean Academy and Tufts College. At the outbreak of the war he organized the Tufts Ambulance Unit, which upon arrival in France was immediately inducted into the French Motor Transport Service. Within four days after arriving at Bordeaux the unit was sent to the front, and saw service in the Aisne Sector between Soissons and Rheims. Since the war, Mr. Miller has been an instructor of English at Tufts College. He is a prominent member of the Pheta Delta Phi Fraternity and is married and has a little baby girl.

When Doctor Sven Hedin, world-famous Swedish explorer and writer, speaking in the studio of KHJ, (The Times, Los Angeles, Calif.), recently thrilled Radiolanders with an account of his hazardous exploration of the Thibetan Desert, he was equally thrilled with this, his first experience in a broadcast studio

A Broadcasting Station Without a Studio

By S. R. WINTERS

A RADIO broadcasting station without a studio and with its programs originating in New York City, is the unique position occupied by the broadcasting station of the Chesapeake and Potomac Telephone Company, Washington, D. C., whose call letters are WCAP. The music, both vocal and instrumental, and other forms of entertainment dispersed by WEAF, the broadcasting station of the American Telephone and Telegraph Company of New York City, are simultaneously disseminated from the ninth floor of a building located at 725 Thirteenth Street, Northwest, in the national capital.

Direct transmission from the studio of the broadcasting station of the American Telephone and Telegraph Company, 195 Broadway, to Washington, a distance of 238 miles, is accomplished by means of the long-distance wire service of this company. Three telephone wires are in reserve for this purpose—a regular wire, an emergency wire, and an order wire. The emergency electric circuit is pressed into service in case the regular wire becomes inoperative, and the order wire is a means for conducting conversation between Washington and New York City concerning the broadcasting service. For instance, if the musical programs are lacking in clarity the New York station is so informed by an operator in Washington, D. C.

Other than the absence of a studio or the necessity for arranging its own programs, WCAP is an honest-to-goodness radio-telephone broadcasting station—in fact, it is perhaps the most powerful non-government station between Philadelphia and Atlanta. At the latter city, the electric equipment of the "Atlanta Journal" is a duplicate of that installed by the Chesapeake and Potomac Telephone Company in Washington. Both of these installations are of 500-watt power, representing the most powerful broadcasting equipment manufactured by the Western Electric Company. Thus, the equipment at the national capital qualifies as a class B, 500-watt transmitting station. It operates on a wave length of 469 meters. WEAF of New York City, and the counterpart of WCAP, however, broadcasts on a wave length of 492 meters.

The room reserved for the installation of electrical equipment of the broadcasting station of the Chesapeake and Potomac Telephone Company covers an area of 1,460 square feet, which is literally jammed with apparatus necessary for radiating music and other kinds of entertainment on electro-magnetic waves within a radius of hundreds of miles of the national capital. The radio room is on the top floor of a magnificent building, which was erected in 1918 at a cost exceeding $1,000,000, and is the headquarters for the officials and administrative employees of the Chesapeake and Potomac Telephone Company.

The antenna of WCAP is formed by extending four strands of wire from an 80-foot mast atop the administrative building to a mast on top of another building, 250 feet distant. Thus the four-wire antenna, taking the shape of the letter T, is 250 feet long. The administrative building is 125 feet high, and by adding another 80 feet, the mast on this structure towers a distance of 205 feet from the ground.

WCAP, Washington, D. C. The broadcast station of the Chesapeake and Potomac Telephone Company is shown here. An interior view is exhibited on page 33

BROADCASTING STATION DIRECTORY

(Revised to November 20th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop.....Monterey, Calif.	261
KLS	Warner Brothers.....Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNJ	Roswell Public Service Co.....Roswell, N. M.	250
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	286
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros.....San Francisco, Calif.	423
KQI	University of California.....Berkeley, Calif.	360
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreld.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
KSD	Post-Dispatch.....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co...San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop.....Honolulu, T. H.	360
KYW	Westinghouse Elec. & Mfg. Co.....Chicago, Ill.	536
KZM	Preston, D. Allen.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDLY	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre .....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology....Portland, Ore.	360
KDYS	The Tribune, Inc.....Great Falls, Mont.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co...Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company.....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co.....Reno, Nev.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZT	Seattle Radio Association.....Seattle, Wash.	360
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	360
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	Electric Shop.....Moscow, Idaho	360
KFAP	Standard Publishing Co.....Butte, Mont.	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAY	W. J. Virgin .....Medford, Ore.	283
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill.....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCB	W. K. Azbill.....San Diego, Calif.	278
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCL	Los Angeles Union Stock Yds..Los Angeles, Calif.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....LeMars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDB	Mercantile Trust Co.....San Francisco, Calif.	509
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agri. College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. E. Cutting.....Bozeman, Mont.	248
KFDP	Hawkeye Radio & Supply Co....Des Moines, Ia.	278
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	360
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEP	Radio Equipment Co.....Denver, Colo.	240
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Douglas, Wyo.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs..St. Louis, Mo.	360
KFFA	Dr. R. O. Shelton.....San Diego, Calif.	242
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Ore.	229
KFFP	First Baptist Church.....Moberly, Mo.	275
KFFQ	Markschoffel Motor Co....Colorado Springs, Colo.	360
KFFR	Jim Kirk.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co.....Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Mo., 138th Inf..St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGP	Cheney Radio Co.....Cheney, Kans.	229
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Co..Berrien Spgs., Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	The Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHJ	Fallon Co. .....Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip Laskowitz.....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co. Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co..Juneau, Alaska	226
KFIV	V. H. Broyles.....Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ, of Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories.....Seattle, Wash.	236
KFIZ	Daily Commonwealth .....Fond du Lac, Wisc.	273
KFJA	Central Power Co.....Brand Island, Nebr.	244
KFJB	Marshall Electric Co., Inc....Marshalltown, Iowa	248
KFJC	Post Intelligencer .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co....Oklahoma City, Okla.	252
KFJH	The Sugar Bowl.....Selma, Calif.	273
KFJI	Liberty Theatre.....Astoria, Ore.	252
KFJJ	Carrollton Radio Shop.....Carrollton, Mo.	236
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJR	Ashley C. Dixon & Co.....Stevensville, Mont.	258
KFJU	Central Power Co.....Kearney, Nebr.	234
KFJV	T. H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories..... Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Electric Co.....Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co..Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Monominee, Mich.	248
KFLD	Paul E. Greenlaw .....Franklinton, La.	234
KFLE	National Educational Service.....Denver, Colo.	268
KFLH	Erickson Radio Co., Inc....Salt Lake City, Utah	261
KFLP	Everett M. Foster .....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop .....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. M.	254
KFLU	Rio Grande Radio Supply House..San Benito, Tex.	236
KFLV	Rev. A. T. Frykman.....Rockford. Ill.	229
KFLW	Missoula Electric Supply Co....Missoula, Mont.	234
WBL	T. & H. Radio Co.....Anthony, Kansas	261
WBS	May & Co.....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBU	City of Chicago.....Chicago, Ill.	286
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCE	Findley Electric Co.....Minneapolis, Minn.	360
WCK	Stix-Baer-Fuller .....St. Louis, Mo.	360
WCM	University of Texas.....Austin, Texas	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDM	Church of the Covenant.....Washington, D. C.	360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co.....St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	360
WGY	General Electric Co.....Schnectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHD	West Virginia University..Morgantown, W. Va.	360
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre....New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cino Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co.....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp. of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America—Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKC	Joseph M. Zamoiski Co.....Baltimore, Md.	360
WKY	Oklahoma Radio Shop....Oklahoma City, Okla.	360
WLB	University of Minnesota.....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co. .....Indianapolis, Ind.	360
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMH	Precision Equipment Co.....Cincinnati, Ohio	248
WMU	Doubleday-Hill Elec. Co.....Pittsburgh, Pa.	261
WNJ	Shotten Radio Mfg. Co.....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic...Davenport, Iowa	484
WOI	Iowa State College .....Ames, Iowa	360
WOK	Arkansas Light & Power Co....Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co. .....Kansas City, Mo.	360
WOR	L. Bamberger Co. .....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record .....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm.....New Lebanon, Ohio	234
WPI	Electric Supply Co.....Clearfield, Pa.	360
WQX	Walter A. Kushi .....Chicago, Ill.	360
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co....Hamilton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co.....Utica, N. Y.	273
WSY	Alabama Power Co. .....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co. .....Toledo, Ohio	360
WTG	Kansas State Agr. College....Manhattan, Kans.	360
WTP	George M. McBride .....Bay City, Mich.	360
WWB	Daily News Printing Co.....Canton, Ohio	360
WWI	Ford Motor Co. .....Dearborn, Mich.	273
WWJ	The Detroit News .....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WWZ	John Wanamaker .....New York, N. Y.	360
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal.....Chicago, Ill.	286
WAAH	Commonwealth Electric Co.....St. Paul, Minn.	360
WAAK	Gimbel Bros. .....Milwaukee, Wisc.	280
WAAM	L. R .Nelson Co. .....Newark, N. J.	263
WAAN	University of Missouri .....Columbia, Mo.	264
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co. .....Decatur, Ga.	360
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co. .....Emporia, Kans.	360
WABA	Lake Forest College .....Lake Forest, IL.	266
WABB	Dr. John B. Lawrence.....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.....Anderson, Ind.	229
WABD	Parker High School .....Dayton, Ohio	286
WABE	Y. M. C. A. .....Washington, D. C.	283
WABF	Mt. Vernon Register-News Co..Mt. Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co....Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College.....Storrs, Conn.	283
WABM	F. E. Doherty .....Saginaw, Mich.	254
WABN	Waldo C. Grover .....La Crosse, Misc.	234
WABO	Lake Avenue Baptist Church...Rochester, N. Y.	252
WAJV	Indian Pipe Line Corp.....Princeton, Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co. .....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation .....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub .Co., The Star Telegram, Ft. Worth, Tex.	476
WBAV	Erner & Hopkins Co. .....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	246
WBAX	John H. Stenger, Jr.....Wilkes Barre, Pa.	360
WBAY	Western Electric Co. .....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBC	Sterling Radio Equipment Co.....Sterling, Ill.	229
WBBD	Barbey Battery Service .....Reading. Pa.	224
WCAD	St. Lawrence University .....Canton, N. Y.	280
WCAE	Kaufman & Baer Co.....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall .....New Orleans, La.	268
WCAH	Entrekin Electric Co. .....Coumbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel .....Houston, Tex.	360
WCAL	St. Olaf College .....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co. .....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co.....San Antonio, Tex.	360

WCAS	Dunwoody Industrial Institute, Minneapolis, Minn.	246
WCAT	South Dakota School of Mines..Rapid City, S. D.	240
WCAU	Durham & Co. .....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont .....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Music House, Milwaukee, Wisc.	261
WCAZ	Carthage College .....Carthage, Ill.	246
WCBA	Charles W. Haimbach .....Allentown, Pa.	280
WCBB	K. & K. Radio Supply Co....Greenville, Ohio	240
WCBD	Zion Radio Broadcasting Station.....Zion, Ill.	345
WDAD	Central Kansas Radio Supply..Lindsborg, Kans.	360
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star .....Kansas City, Mo.	411
WDAG	Martin J. Laurence .....Amarillo, Tex.	263
WDAH	Trinity Methodist Church .....El Paso, Texas	268
WDAI	Hughes Radio Corporation.....Syracuse, N. Y.	246
WDAK	Hartford Courant .....Hartford, Conn.	261
WDAL	Florida Times Union .....Jacksonville, Fla.	360
WDAM	Weston Electric Co. .....New York, N. Y.	360
WDAO	Automotive Electric Co. .....Dallas, Tex.	360
WDAP	The Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers .....Philadelphia, Pa.	395
WDAS	Samuel W. Waite .....Worcester, Mass.	360
WDAU	Slocum & Kilburn .....New Bedford, Mass.	360
WDAX	First National Bank .....Centerville, Iowa	268
WDAY	Fargo Radio Service Co.....Fargo, N. D.	244
WDBC	Kirk Johnson & Co., Inc.....Lancaster, Pa.	258
WDBF	Robert G. Phillips .....Youngstown, Ohio	261
WEAA	Fallain & Lathrop.....Flint, Mich.	280
WEAB	Standard Radio Equipment Co..Fort Dodge, Ia.	360
WEAE	Virginia Polytechnic Institute...Blacksburg, Va.	360
WEAF	American Tel. & Tel.....New York, N. Y.	492
WEAG	Nichols Hineline Bassett Laboratory, Edgewood, R. I.	231
WEAH	Wichita Board of Trade.....Wichita, Kans.	244
WEAI	Cornell University.....Ithaca, N. Y.	286
WEAJ	University of South Dakota....Vermillion, S. D.	360
WEAM	North Plainfield, Borough of N. Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. .....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co., Inc.....Mobile, Ala.	360
WEAR	Baltimore Am. & News Pub. Co., Baltimore, Md.	360
WEAS	Hecht Company .....Washington, D. C.	360
WEAU	Davidson Brothers Co. .....Sioux City, Iowa	360
WEAY	Will Horwitz, Jr. .....Houston, Tex.	360
WEAZ	Donald Redmond .....Waterloo, Iowa	360
WFAA	A. H. Belo & Co. .....Dallas, Tex.	476
WFAB	Carl C. Woese .....Syracuse, N. Y.	234
WFAF	Henry C. Spratley .....Poughkeepsie, N. Y.	273
WFAG	Radio Engineering Laboratory, Waterford, N. Y.	360
WFAH	Electric Supply Co. .....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAM	Times Publishing Co. .....St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co...Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo.	360
WFAT	Daily Argus Leader.....Sioux Falls, S. D.	360
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WGAC	Orpheum Radio Stores Co.....Brooklyn, N. Y.	360
WGAD	Spanish Am. Sch. of Telegraphy, Ensonada, P. R.	360
WGAJ	W. H. Glass .....Shenandoah, Iowa	360
WGAL	Lancaster Elec. Supply & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd .....Pensacola, Fla.	360
WGAQ	W. G. Patterson .....Shreveport, La.	360
WGAR	Southern American .....Fort Smith, Ga.	360
WGAU	Marcus G. Limb .....Wooster, Ohio	226
WGAW	Ernest C. Albright .....Altoona, Pa.	261
WGAX	Radio Electric Co., Washington Courthouse, Ohio	360
WGAY	North Western Radio Co.....Madison, Wisc.	360
WGAZ	South Bend Tribune .....South Bend, Ind.	360
WHAA	State University of Iowa.....Iowa City, Iowa	283
WHAB	Clark W. Thompson .....Galveston, Tex.	360
WHAC	Cole Brothers Elec. Co.....Waterloo, Iowa	360
WHAD	Marquette University .....Milwaukee, Wisc.	360
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	J. T. Griffin .....Joplin, Mo.	360
WHAK	Roberts Hardware Co....Clarksburg, West. Va.	258
WHAL	Lansing Capital News .....Lansing, Mich.	248
WHAM	Eastman School of Music of Univ. of Rochester, Rochester, N. Y.	283
WHAP	Dewey L. Otta .....Decatur, Ill.	360
WHAQ	Semmes Motor Co. .....Washington, D. C.	242
WHAR	Paramount Radio and Elec. Co., Atlantic City, N. J.	231
WHAS	Courier Journal & Times.....Louisville, Ky.	400
WHAV	Wilmington Elec. & Supply Co., Wilmington, Del.	360
WHAX	Huntington Press .....Huntington, Ind.	360
WHAZ	Rensselaer Polytechnic Institute.....Troy, N. Y.	380
WIAB	Joslyn Automobile Co. .....Rochford, Ill.	360
WIAD	Ocean City Yacht Club.....Ocean City, N. J.	254
WIAF	Gustav A. De Cortin.....New Orleans, La.	234
WIAH	Continental Radio and Mfg. Co., Inc., Newton, Iowa	258
WIAI	Heers Stores Co. .....Springfield, Mo.	252
WIAK	Journal Stockman Co. .....Omaha, Nebr.	278
WIAP	J. A. Rudy & Sons.....Paducah, Ky.	360
WIAQ	Chronicle Publishing Co. .....Marion, Ind.	226
WIAS	Burlington Hawkeye-Home Elec. Co., Burlington, Ia.	360
WIAT	Leon T. Noel .....Tarkio, Mo.	360
WIAU	American Sec. & Sav. Bank.....Le Mars, Ia.	360
WIAV	New York Radio Laboratories, Binghamton, N. Y.	360
WIAW	Saginaw Radio & Elec. Co.....Saginaw, Mich.	360
WJAD	Jackson's Radio Eng. Lab.....Waco, Tex.	360
WJAF	Press Pub. Co. .....Muncie, Ind.	360
WJAG	Huse Publishing Co. .....Norfolk, Nebr.	360
WJAJ	Y. M. C. A. .....Dayton, Ohio	360
WJAK	Rev. C. L. White.....Greentown, Ind.	254
WJAM	D. C. Perham .....Cedar Rapids, Iowa	268
WJAN	Peoria Star Co. .....Peoria, Ill.	280
WJAR	The Outlet Co. .....Providence, R. I.	360
WJAS	Capper Publications .....Topeka, Kans.	360
WJAT	Kelly-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co. .....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory .....Chicago, Ill.	448
WKAA	H. F. Paar .....Cedar Rapids, Iowa	268
WKAD	Charles Looff .....East Providence, R. I.	240
WKAF	W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.	360
WKAN	Alabama Radio Mfg. Co.....Montgomery, Ala.	360
WKAP	Dutee Wilcox Flint .....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College.....East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.....Springfield, Mo.	360
WKAV	Laconia Radio Club .....Laconia, N. H.	254
WKAW	United Battery Service Co., Montgomery, Ala.	226
WKAX	W. A. Macfarlane.....Bridgeport, Conn.	231
WKAY	Brenau College .....Gainesville, Ga.	280
WLAC	North Carolina State College...Raleigh, N. C.	360
WLAG	Cutting & Washington Radio Corp., Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Mach. Co.....Bellows Falls, Vt.	360
WLAL	Tulsa Radio Co. .....Tulsa, Okla.	360
WLAN	Putnam Hardware Co. .....Houlton, Me.	283
WLAP	W. V. Jordon .....Louisville, Ky.	360
WLAQ	A. E. Schilling .....Kalamazoo, Mich.	360
WLAS	Central Radio Supply Co.....Hutchinson, Kans.	244
WLAT	Radio and Specialty Co.....Burlington, Iowa	360
WLAV	Electric Shop, Inc. .....Pensacola, Fla.	254
WLAW	New York Police Dept.....New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station, Greencastle, Ind.	231
WMAB	Radio Supply Co.....Oklahoma City, Okla.	360
WMAC	J. Edward Page .....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co. .....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co. .....Kansas City, Mo.	275
WMAK	Norton Laboratories .....Lockport, N. Y.	360
WMAL	Trenton Hdw. Co. .....Trenton, N. J.	250
WMAN	First Baptist Church .....Columbus, Ohio	286
WMAP	Utility Battery Service, Inc.....Easton, Ohio	246
WMAQ	Chicago Daily News .. ..Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAW	Wahpeton Elec. Co. .....Wahpeton, N. D.	360
WMAY	Kingshighway Presby. Church....St. Louis, Mo.	280
WMAZ	Mercer University .....Macon, Ga.	268
WNAB	Park City Daily News....Bowling Green, Ky.	360
WNAC	Shepard Stores .....Boston, Mass.	278
WNAD	Oklahoma Radio Eng. Co.....Norman, Okla.	360
WNAL	R. J. Rockwell .....Omaha, Nebr.	242
WNAM	Ideal Apparatus Co. .....Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co..Syracuse, N. Y.	286
WNAP	Wittenberg College .....Springfield, Ohio	360
WNAQ	Charleston Radio Elec. Co.....Charleston, S. C.	360
WNAR	Rhodes, C. C. .....Butler, Mo.	231
WNAS	Texas Radio Corporation and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Bros. Co. .....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Tel. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzmann .....Fortress Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.....Yankton, S. D.	244
WNAY	Ship Owners' Radio Service.....Baltimore, Md.	360
WOAA	Dr. Walter Hardy .....Ardmore, Okla.	360
WOAC	Maus Radio Co. .....Lima, Ohio	266
WOAD	Friday Battery & Elec. Co.....Sigourney, Iowa	360
WOAE	Midland College .....Fremont, Nebr.	360
WOAF	Tyler Commercial College .....Tyler, Tex.	360
WOAG	Apollo Theatre .....Belvidere, Ill.	224
WOAH	Palmetto Radio Corp. .....Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Texas	385
WOAJ	Ervin's Electrical Co. .....Parsons, Kans.	360
WOAK	Collins Hardware Co. .....Frankfort, Ky.	240
WOAL	Wm. Evans Woods .....Webster Groves, Mo.	286
WOAN	James D. Vaughan .....Lawrenceburg, Tenn.	360
WOAP	Kalamazoo College .....Kalamazoo, Mich.	360
WOAT	Boyd Martell Hamp .....Wilmington, Del.	360
WOAV	Pennsylvania National Guard.....Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Nebr.	526
WOAX	Franklyn J. Wolff .....Trenton, N. J.	240
WOAZ	Penick Hughes Co. .....Stanford, Tex.	360
WPAB	Pennsylvania State College....State College, Pa.	360
WPAC	Donaldson Radio Co. .....Okmulgee, Okla.	360
WPAD	Wieboldt & Co. .....Chicago, Ill.	360
WPAG	Central Radio Co., Inc.....Independence, Mo.	360
WPAH	Wisconsin Dept. of Markets....Waupaca, Wisc.	360
WPAJ	Doolittle Radio Corporation..New Haven, Conn.	268
WPAK	No. Dakota Agricultural College...Fargo, N. D.	360
WPAL	Superior Radio & Telephone Co., Columbus, Ohio	286
WPAM	Awerbach & Guettel .....Topeka, Kans.	360
WPAP	Theodore D. Phillips .....Winchester, Ky.	360
WPAQ	General Sales & Eng. Co.....Frostburg, Md.	360
WPAR	R. A. Ward .....Beloit, Kans.	360
WPAS	J. & M. Electric Co.....Amsterdam, N. Y.	360
WPAT	St. Patrick's Cathedral .....El Paso, Tex.	360
WPAU	Concordia College .....Moorhead, Minn.	360
WPAY	Bangor Radio Laboratory .....Bangor, Me.	360
WPAZ	John R. Koch .....Charleston, West Va.	273
WQAA	Horace A. Beale, Jr.....Parkersburg, W. Va.	360
WQAB	Southwest Missouri State Teachers College, Springfield, Mo.	236
WQAC	E. B. Gish .....Amarillo, Tex.	360
WQAD	Whitehall Electric Co. .....Waterbury, Conn.	242
WQAE	Moore Radio News Station.....Springfield, Vt.	275
WQAF	Sandusky Register .....Sandusky, Ohio	240
WQAH	Brock Anderson Elec. Eng. Co., Lexington, Ky.	254
WQAK	Appel-Higley Electric Co.....Dubuque, Iowa	360
WQAL	Cole County Tel. & Tel. Co.....Mattoon, Ill.	258
WQAM	Electrical Equipment Co. .....Miami, Fla.	360
WQAN	Scranton Times .....Scranton, Pa.	360
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	West Texas Radio Co.....Abilene, Tex.	360
WQAS	Prince Walter Co. .....Lowell, Mass.	266
WQAT	Radio Equipment Corporation.....Richmond, Va.	360
WQAV	Huntington and Guerry, Inc....Greenville, S. C.	258
WQAW	Catholic University of America, Washington, D. C.	236
WQAX	Radio Equipment Co. .....Peoria, Ill.	360
WQAZ	Greensboro Daily News.....Greensboro, N. C.	360
WRAA	Rice Institute .....Houston, Tex.	360
WRAD	Taylor Radio Shop .....Marion, Kans.	248
WRAF	Radio Club, Inc. .....Laporte, Ind.	224
WRAH	Stanley N. Reed .....Providence, R. I.	231
WRAL	Northern States Power Co...St. Croix Falls, Wisc.	248
WRAN	Black-Hawk Electric Co.....Waterloo, Iowa	236
WRAO	Radio Service Co. .....St. Louis, Mo.	360
WRAP	Winter Park Elec. Construction Co., Winter Park, Fla.	360
WRAU	Amarillo Daily News .....Amarillo, Tex.	360
WRAV	Antioch College .....Yellow Springs, Ohio	360
WRAW	Horace D. Good .....Reading, Pa.	238
WRAX	Flexon's Garage .....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation .....Scranton, Pa.	280
WRAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WSAA	B. S. Sprague Elec. Co.....Marietta, Ohio	360
WSAB	Southeast Mo. State College, Cape Girardeau, Mo.	360
WSAC	Clemson Agri. College....Clemson College, S. C.	360
WSAD	J. A. Foster Co. .....Providence, R. I.	261
WSAH	A. G. Leonard, Jr. .....Chicago, Ill.	248
WSAI	U. S. Playing Card Co.....Cincinnati, Ohio	309
WSAJ	Grove City College .....Grove City, Pa.	360
WSAK	Daily News .....Middleport, Ohio	258
WSAL	Franklin Electrical Co.....Brookville, Ind.	246
WSAN	Allentown Radio Club .....Allentown, Pa.	229
WSAP	Seventh Day Adventist Church..New York, N. Y.	263
WSAR	Doughty & Welch Elec. Co....Fall River, Mass.	254
WSAT	Plainview Elec. Co. .....Plainview, Tex.	268
WSAW	Curtice & McElwee .....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WSAY	Irving Austin, Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop .....Pomeroy, Ohio	258
WTAB	Fall River Daily Herald.....Fall River, Mass.	248
WTAC	Penn Traffic Co. .....Johnstown, Pa.	360
WTAD	Robert E. Compton .....Carthage, Ill.	229
WTAG	Kern Music Co. .....Providence, R. I.	258
WTAH	Carmen Ferro .....Belvidere, Ill.	236
WTAJ	The Radio Shop .....Portland, Me.	236
WTAL	Toledo Radio and Electrical Co., Toledo, Ohio	252
WTAM	Willard Storage Battery Co....Cleveland, Ohio	390
WTAN	Orndorff Radio Shop .....Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	390
WTAQ	S. H. Van Gorden & Son.....Osseio, Wisc.	226
WTAR	Reliance Electric Co. .....Norfolk, Va.	226
WTAS	Charles E. Erbstein.....Elgin, Ill.	275
WTAT	Edison Elect. Ill. Co.....Boston, Mass.	244
WTAU	Ruegy Battery & Elec. Co.....Tecumseh, Nebr.	360
WTAW	Agricultural and Mech. College, College Station, Tex.	254
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill.	226
WTAZ	Thomas J. McGuire .....Lambertville, N. J.	283
WWAB	Swern Hoenig & Co.....Trenton, N. J.	226
WWAC	Sanger Brothers .....Waco, Tex.	360
WWAD	Wright & Wright, Inc.....Philadephia, Pa.	360
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAH	General Supply Co. .....Lincoln, Nebr.	360
WWAX	Worman Brothers .....Laredo, Tex.	360

Canadian Broadcasting Stations

CKY	Manitoba Telephone System.....Winnipeg, Manitoba	
CFAC	Radio Corporation of Calgary, Ltd...Calgary, Alberta	
CFCA	Star Publishing and Printing Co., Toronto, Ontario	
CFCB	Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.	
CFCD	Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba	
CFCE	Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia	
CFCF	Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec	
CFCH	Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario	
CFCI	Motor Products Corporation.....Walkerville, Ontario	
CFCN	W. W. Grant Radio, Ltd.....Calgary, Alberta	
CFCX	The London Advertiser.....London, Ontario	
CFPC	International Radio Development Co., Fort Frances, Ontario	
CFTC	The Bell Telephone Co. of Canada....Toronto, Ontario	
CFUC	University of Montreal.....Montreal, Quebec	
CFVC	Roy Russell Brown.....Courtenay, British Columbia	
CFYC	Victor Wentworth Odium.....Vancouver, B. C.	
CFZC	Canadian Westinghouse Co., Ltd.....Montreal, Quebec	
CHAC	Radio Engineers, Ltd.....Halifax, Nova Scotia	
CHBC	The Albertan Publishing Co.....Calgary, Alberta	
CHCA	Radio Corporation of Vancouver, Ltd., Vancouver, B. C.	
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario	
CHCC	Canadian Westinghouse Co., Ltd., Edmonton, Alberta	
CHCF	Radio Corporation of Winnipeg, Ltd., Winnipeg, Manitoba	
CHCQ	The Western Radio Co., Ltd.....Calgary, Alberta	
CHCS	London Radio Shoppe .....London, Ontario	
CHCX	B. L. Silver .....Montreal, Quebec	
CHCZ	The Globe Printing Co. .....Toronto, Ontario	
CHFC	John Millen & Sons, Ltd.....Toronto, Ontario	
CHIC	Canadian Westinghouse Co., Ltd....Hamilton, Ontario	
CHOC	Canadian Westinghouse Co., Ltd....Vancouver, B. C.	
CHVC	Metropolitan Motors, Ltd. .....Toronto, Ontario	
CHXC	J. R. Booth, Jr. .....Ottawa, Quebec	
CHYC	Northern Electric Co. .....Montreal, Quebec	
CJBC	Dupuis Freres .....Montreal, Quebec	
CJCA	The Edmonton Journal, Ltd.....Edmonton, Alberta	
CJCB	James Gordon Bennett .....Nelson, British Columbia	
CJCD	T. Eaton Co., Ltd. .....Toronto, Ontario	
CJCE	Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.	
CJCF	News Record, Ltd. .....Kitchener, Ontario	
CJCG	Manitoba Free Press Co., Ltd....Winnipeg, Manitoba	
CJCH	The United Farmers of Ontario.....Toronto, Ontario	
CJCI	McLean, Holt & Co., Ltd....St. John, New Brunswick	
CJCN	Simons Agnew & Co. .....Toronto, Ontario	
CJCS	Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia	
CJCY	Edmund Taylor .....Calgary, Alberta	
CJGC	London Free Press Printing Co., Ltd., London, Ontario	
CJNC	Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba	
CJSC	The Evening Telegram .....Toronto, Ontario	
CKAC	La Presse Publishing Co.....Montreal, Quebec	
CKCB	T. Eaton Co., Ltd. .....Winnipeg, Manitoba	
CKCD	Vancouver Daily Province .....Vancouver, B. C.	
CKCE	Canadian Independent Telephone Co., Ltd., Toronto, Ontario	
CKCK	Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan	
CKCR	Jones Electric Radio Co.....St. John, New Brunswick	
CKCS	The Bell Telephone Co. of Canada...Montreal, Quebec	
CKCZ	Canadian Westinghouse Co., Ltd.....Toronto, Ontario	
CKKC	Radio Equipment and Supply Co....Toronto, Ontario	
CKOC	The Wentworth Radio Supply Co....Hamilton, Ontario	
CKQC	Radio Supply Co. of London.....London, Ontario	
CKZC	Salton Radio Engineering Co....Winnipeg, Manitoba	

Afloat and Ashore With the Operator

As Reported by W. S. Fitzpatrick

AN interesting place for one to visit—especially for a student of psychology—is a marine radio office the day before a busy sailing morning, when the operators are making their final reports and arranging for supplies needed for their voyages.

The office in America from where the greatest number of operators are dispatched to ships is, of course, located in New York. The visitor observes only an assembly of men, some quite young and a few well on in years, none giving outward signs to indicate that he is other than one of a crowd of ordinary fellows in whom no cause for special interest can be seen. But there's a fund of interest here!

On one side of the office is a smiling young chap calmly preparing to sail for France. He is Herbert McCeney, who was picked up at sea after swimming unaided about an hour following the sinking of the steamship *Lake Frampton* three years ago. The tall fellow who just passed him is R. L. Etheridge, who almost lost his life with the sinking of the *Munroe* in 1914, in which his partner perished. He is preparing for a trip to ports on the Gulf of Mexico.

Passing out the door on his way for a long trip to South American ports is Joe Welch, who twice proved himself a hero and as many times experienced anxious hours in an open boat in the middle of the Atlantic after German submarines had paid their visits.

Awaiting his turn at the desk so as to be cleared before his departure for Japan and China is G. B. Rabbitts, another who experienced the thrill of having his ship torpedoed and sunk in mid-ocean.

Among the crowd, too, is seen the dignified figure of E. N. Pickerill, a radio man of 18 years' service and now chief on the *Leviathan*. Two of his five assistants are preparing for the trip to England from which they expect to be back in less than three weeks.

Near him is Ben Beckerman, who has had 15 years of radio experience. Ben is on a run to Norfolk which brings him back to New York twice a week.

The sailor-looking man who, incidently, is an ex-soldier and who was wounded in battle, you would surely say is about to sail on at least a year's voyage. He is on a harbor tug boat! That timid-looking very young fellow with the refined manner you would imagine is on one of the over-night passenger boats. Through his own request he is about to sail on a five months' voyage to South Africa, on which he will visit not only Cape Town, Durban and Madagascar Island, but semi-civilized towns up African rivers, and this is not his first long trip.

C. S. Thevenet, senior operator of the new Savannah liner "City of Chattanooga." He has served in that line four years

Yes, a marine radio office is an ideal place for a trained psychologist. There is a gathering of men and boys from all ranks: run-away farm boys, who never before saw a ship, to college graduates who formerly spent their vacation periods on the water; from ex-army privates to lieutenants, captains and majors, and from former apprentice seamen to naval officers.

As the crowd at the office begins to grow smaller the realization comes that this same assembly will never again be together. The men are leaving for all parts of the globe; some to return soon and others not for many months. They may pass on ships at sea and may communicate between themselves at great distances; and friends may in time come together, in this or in distant ports, but the same crowd will never be, for each day's gathering at a radio office is different.

* * *

Some folks hold the opinion that radio operators are thin fellows capable of passing behind panel sets and making themselves comfortable in the small cabins found on some ships. They should see the famed operator Bandettini on the steamer *Clauseus*. Born and bred in Michigan he started crossing the Atlantic about three years ago when he weighed about 180. Since then he has grown to around 280, and is still going strong. His joining the Elks a few months ago certainly didn't take any weight off, but rather added to it, say his friends.

* * *

The Elks is popularly known as an order of prosperous gentlemen. It is fairly well represented among the seagoing radio men. F. N. Normandin, running on the *Swiftwind* between Providence and San Pedro, is one of the latest to join. Four members of that order recently left the sea: Clyde Diderick is now the proprietor of a restaurant in Prangeville, Ill.; Edward Freeman is one of the staff at the WJZ broadcasting station in New York City. A. E. Ermatinger is now located in the middle west and Bill Ferrick is in the Shipping Board's London office.

* * *

Mentioning Bill Ferrick's name brings to the fore one of the old time radio men about whom there are many inquiries, especially among the army of ex-operators. He has a pretty good berth as operator at the United States Shipping Board's receiving station in London, England. Ferrick's radio service has been a long and varied one, broken only by the couple of years spent as postmaster of a small town above New York City. Since then and up to his taking his present position he was chief operator on trans-Atlantic passenger ships. Many years ago Ferrick was at different times manager of coast stations, notably those at New York, Charleston and Jacksonville, all three of which have long since been discontinued.

* * *

A remarkable reception record was made by Jack O'Connell, mate and radio operator on E. W. Scripps' yacht *Ohio*, on the night of President Harding's death, when he obtained over a thousand words of press while the vessel was west of the Fiji Islands. By nine o'clock on the night of the President's death, O'Connell had his story complete and handed in to the owner of the yacht. Upon arrival at Suva, Fiji, the following day the local newspapers, which had only received bare facts, got real details from those aboard the yacht. Some of the items were received at a distance of 7,000 miles from the transmitting station.

Marconi Transmits on New Waves

ANOTHER step in the development of wireless telegraphic transmission has been realized, says Senatore Marconi, who has returned to London after a two months' experimental cruise in his yacht, according to a London dispatch. A system has been evolved whereby wireless messages are transmitted with a minimum of electrical power, and at very low cost.

"We have transmitted messages up to a distance of 2,250 miles, not only with a very much smaller amount of power and energy, but faster and more cheaply than with the ordinary system of long-distance wireless," said Senatore Marconi.

"When the new system is adopted it will mean that a power station for long-distance work can be erected at much less cost than at present. I have telegraphed on this system from Cape Verde Island, off the African coast, to London. To send messages clearly and more rapidly over those 2,500 miles took less power than a message from London to Paris by the ordinary methods."

Senatore Marconi explained that these advantages were gained by the utilization of waves that have not before been used.

France Increases Ship Radio Requirements

THE recent French radio requirements for vessels extending the range of transmission fifty miles, also affect all foreign ships touching at French ports since October 6. The French radio decree, signed last spring, but which only reached this country last month, provides that all vessels of 2,000 gross tons, all ships licensed to carry 50 persons, including the crew, and also all craft having as many as twelve passengers aboard, must be equipped to send and receive wireless messages by day up to 150 nautical miles.

Merchant ships between 500 and 2,000 gross tons, licensed to carry less than fifty persons, or with less than 15 passengers aboard, must be capable of receiving radio signals up to 2,800 meters and preserve a watch for emergency calls.

In establishing the minimum of 150 miles for first class ship radio transmission, fifty miles farther than the regulations of the International Convention of London in 1914, the American Law of 1910, and the British regulations of 1919 provide, France has taken a step forward in making for better protection of life at sea. The increase of fifty miles is not at all out of proportion, however, with the progress made in radio telegraph transmission during the past ten years.

The French decree of 1923 makes it mandatory upon the master, who receives a wireless distress call, to proceed to the ship's aid; this decree also increases the number of responsible ships by requiring all French merchantmen and fishermen over 500 tons to carry radio receiving equipment even though not equipped with transmitters. This involves a practical acquaintance with wireless signals by at least one of the crew, who must be certified by the government. It is a self-denying ordinance, but is in the interest of humanity in general; obviously the master getting an "SOS" call must start for the scene, although he could not himself issue such a call for aid. The masters, however, are benefited by receiving meteorological, time and position signals and in keeping in touch with world events, depending upon the skill of their wireless watcher or listener-in.

The new French regulations will make it practically necessary for other nations to adopt the same transmission limits and minimum tonnage. The International Convention will also be concerned in an effort to preserve uniformity of radio laws.

It is understood that the State Department Committee on Electrical Communications, which now meets frequently, will consider the phases of this law which affect United States ships.

Boston Radio Show

BOSTON'S third annual radio exposition will be held on December 3, in Horticultural Hall, where it is believed better facilities for displaying the latest in radio may be had. In addition to a large number of displays by manufacturers and dealers, there will be lectures, movies of radio subjects, prize contests and constructional exhibits. Local broadcasting stations will give special programs and visitors will be given an opportunity to see a special broadcasting studio.

High Power Station Near Cape Town

THE Wireless Telegraph Company of South Africa (Ltd.), has been recently organized to provide international telegraphic service for the Dominion. The principal high-power station is to be located at Klipheuvel Station, Cape Province, about 30 miles by rail from Cape Town. The site comprises about 1,000 morgen—2,110 acres—of farm land and is so located as to be about 10 miles distant from any mountains. It is estimated that the station will be in operation in about eighteen months. The power of the new station will be 750 kilowatts and it is probable that it will operate on a wavelength of about 16,000 meters.

Uncle Sam's radio station at Guam

Poland Circuit Opened

A NEW record for long-distance commercial radio communication was set with the opening of a circuit between Rocky Point, Long Island, and Warsaw, Poland. The space over which the signals must travel is more than one-sixth the distance around the earth.

This circuit, which is a part of the Radio Corporation of America system, was formally opened when officials of the Polish Government and the Radio Corporation exchanged greetings by radio. It marked the first time in history when the United States and Poland were brought into direct communication, without the messages being relayed over land wires through other countries.

The cost of the sending station at Warsaw and receiving station on Long Island was approximately $2,000,000, and the work of building them began in August, 1921.

The transmitting aerial at the Polish station is similar in design to those employed at Radio Central, the Radio Corporation station at Rocky Point, L. I. There are ten steel towers erected on a large tract of land on the outskirts of Warsaw, and these support aerial wires a mile in length. The receiving apparatus consists of a double receiving circuit used in connection with the recently developed wave antenna, which is nine miles long.

Forty engineers and operators are employed at the Warsaw terminal.

The establishment of the new circuit gives Poland political advantages not enjoyed by countries which must relay their messages by land wires under the control of neighboring countries.

Captain Donald B. MacMillan, famous explorer, who from his winter quarters in Refuge Harbor near Etah on the northwest coast of Greenland, has kept in touch with civilization through his radio apparatus (Station WNP). His ship, the "Bowdoin," is reported as being frozen in solid for the next seven or eight months

Liebmann Prize Awarded to Beverage

HAROLD H. BEVERAGE, an engineer of the Radio Corporation of America, was tendered a vote of honor by the membership and board of officers of the Institute of Radio Engineers at their last meeting, for the outstanding radio invention of the year which consisted of his so-called wave antenna. Beverage was also presented with a cash prize of $500, the Liebmann Memorial Prize, this amount being the annual interest on an investment made by the late Colonel Morris Liebmann, a well-known radio engineer. Each year this sum is given to the most deserving individual whose radio inventions or developments are of outstanding practical importance.

NATIONAL RADIO WEEK

The Muses Worked Overtime to Make National Radio Week a Big Event

THE week of November 25th to December 1st was set aside as National Radio Week. And more, it was National "Party" Week for radio fans.

Broadcast stations co-operated with the Radio Trade Association to make that event the biggest, recent celebration on the air. Newspapers throughout the country gave their support by running special stories, increasing their radio features and in some cases through the news columns.

The Wireless Age trusts that listeners invited those of their friends who do not own sets to listen-in one or more evenings during Radio Week. We are sure the programs were especially interesting to fans and well worth their friends' participation in the radio party.

Programs, throughout the event, were arranged to present the breadth of possibilities in entertainment through radio in the home as well as to promote the party spirit that is possible by means of this great vehicle of universal communication.

Radio parties of this sort should become very popular. How else, than through radio, can we have so much real fun in the home? By what other means can we get together so informally, and yet enjoy the full spirit of the party?

National Radio Week was designed for the purpose of extending the field of interest in radio to those who do not realize the range of entertainment to be found in broadcast programs. Those who have receiving sets were urged to spread the gospel of radio joy in the homes of their neighbors. Broadcast stations and publications have done their part, and it is hoped that BCLs. have been doing theirs.

And now, for your part, let your friends "in" on some of the good things you get with your set. Make it a National Radio YEAR.

BERLIN POLICE USE RADIO
Due to disorders in Germany, Berlin police are equipped with radio. This patrol is alert to receive calls for assistance when emergencies arise

Tube "Bootleggers" Arrested

WITH the arrest in Philadelphia of the alleged leader of a gang of "radio bootleggers," the attention of the police and public was again concentrated on an industry valued at many millions of dollars which has been built up around the counterfeiting of vacuum tubes and trade marks of the General Electric Company, Westinghouse Electric and Manufacturing Company and the Radio Corporation of America. According to John S. Harley, special investigator for the Radio Corporation, the Philadelphia arrest is regarded as the key in a situation involving six factories located in Newark and its immediate vicinity.

In order to obtain the necessary evidence against the manufacturers, detectives from New York and Philadelphia have been engaged along Philadelphia's radio row for several weeks. Close observations were kept at that point as well as in Newark, where all of the manufacturing activities took place.

According to the police, the arrest of Thomas F. Cairns, Jr., known as the "king" of radio tube bootleggers, will lead to the arrest of a number of other bootleg tube manufacturers.

The life of the bootleg tube is extremely short, and, although many of them are sensitive at the beginning they lose their value after being burned for a few hours. The dealers in many cases have lost large sums of money through the operation of this ring of radio vacuum tube bootleggers.

A simple set that any amateur can construct

The Wireless Age Uni-Control Receiver

By John R. Meagher

This is the first of a series of sets made in the office of THE WIRELESS AGE. It will be kept on display and any reader who can conveniently do so is urged to visit THE WIRELESS AGE office and examine it

WE are going to describe a receiver that is not only admirably suited for home entertainment, but is electrically one of the very best that can be built. In no sense of the word is it "new"; on the contrary, many years have elapsed since the first of its kind was introduced, but in that time countless developments, changes and improvements have been made. At present it typifies all that is good in the rather neglected quality of reliability.

Of its many excellent merits most emphasis is placed on the extreme simplicity of operation. This receiver has but one dial on which may be marked the call letters of both local and distant stations when they are first heard. At any time thereafter that a certain program is to be received it is necessary merely to turn the dial to a definite point and, if broadcasting, the particular station will be heard! There is no fussing or fuming with countless knobs; there are no trick or delicate adjustments; there is no "combination" to be sought for; there is no waste of time in tuning nor need for "expert" operation. Simply turn the dial to the properly marked point and enjoy the broadcasting.

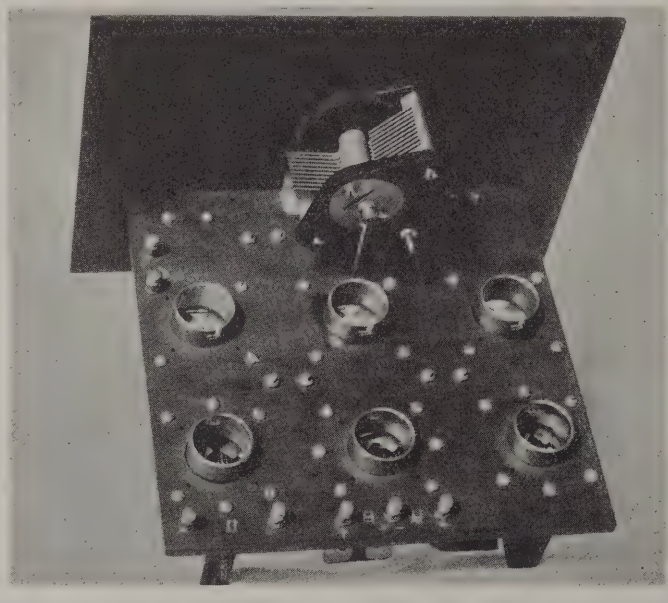
A loop antenna is employed for reception and six vacuum tubes, suitably arranged, enable loud speaker reproduction of stations 1500 miles distant. The amplification is such that it is entirely practicable to operate the set either in a large hall or in the open. Intensity is under positive control through use of a volume regulator—the loud speaker may be made to whisper, talk, shout or bellow at will. And of more than passing interest is the unusual compactness; the front panel is only 7 inches by 10 inches!

Besides being simple in operation, powerful as to amplification and compact, this uni-control outfit is very sensitive and selective. Selectivity, the ability to discriminate between stations and exclude all but the desired program, is obtained through use of a small loop antenna which experts tell us is inherently selective. Sensitivity, the ability to reach out for distant stations, is obtained through employment of radio frequency amplification—a modern adaptation of the "20 league boots" of fairy stories.

. . . . . .

Having personally supervised the construction and testing of hundreds of somewhat similar receivers, no two of which were alike—each being an improvement over the former—and having located the difficulty with those which failed to operate or failed to continue in operation we feel that we can speak with comparative certainty on the subject. Therefore even at the risk of stifling originality we plan to eliminate all uncertainties from the description. There will appear few alternatives, either in design or construction, and it is our desire that the builder adhere very closely to specifications.

This article will cover the design, construction and operation—including testing and trouble shooting hints. Then in a later issue of THE WIRELESS AGE, we shall give further information about loops, how to use an aerial with this set and how to care for the batteries. Thus the entire subject will be covered and if instructions are followed everyone building the single control receiver should have splendid results. If difficulty is encountered the Information Desk of THE WIRELESS AGE will be only too pleased to render assistance. But we do not anticipate many inquiries as the design and construction has been so simplified that a beginner will experience but little trouble in building this single control receiver.



The rear panel on the "W. A. Unicontrol" is only 8" x 8"! Six sockets for UV-199 tubes are mounted on it; from left to right in the top row—1st RF, 2nd RF and detector. From right to left in the bottom row—1st AF, 2nd AF and 3rd AF

DESIGN

In planning this receiver we were tempted to utilize reflex amplification in an endeavor to reduce the contemplated size and cost. On further investigation we found that the additional cost would be only for the vacuum tubes, a fairly low sum. And as to saving space, we were able to reduce the size to such an extent that the six tubes occupy considerably less room than most one-tube receivers. Naturally the filament current consumption of six tubes is greater than that of three or four, but through use of .06 ampere VT's this disadvantage is made almost negligible. In addition, it is our candid belief, obtained through unbiased observation and numerous experiments, that a straight cascade amplifier is superior to the usual run of reflex systems; few people will contest the statement that there is a "certainty" in the amateur construction of cascade amplifiers that is lacking in multi-tube reflexes. And as our prime motive is to describe a set that will work, and work well, and in the construction of which there will be no "guesswork" or "tryouts" we decided to pass up the reflex system.

The complete wiring circuit is shown in figures 1 and 2. It will be seen that there are two stages of radio frequency amplification, a detector and three stages of audio frequency amplification; inter-tube coupling is provided

through suitable iron core radio and audio frequency transformers.

The filament circuit is rather unusual insofar as there is not an iota of wasted energy due to extra filament resistances. The six filaments are arranged in three parallel branches of two each—the resultant current (with UV-199 tubes) being .18 ampere at 6 volts. Note especially that the circuit is so arranged as to permit the grids of the three audio frequency tubes to be at 3 volts difference with respect to the negative terminal of their filaments; necessity for a grid battery is thus obviated. Moreover, by this arrangement the voltage on the grids of each radio frequency amplifier is the same.

A positive acting cut-off switch and a high resistance potentiometer are the only extra equipment in the filament circuit.

In figure 1 particular attention is directed to the radio and audio frequency transformer connections. On the AF transformers G and P represent the outside terminals of the secondary and primary windings; F and +B the inside terminals of the same coils. The RF transformer connections are suitable for "DX"—"Virbren" type; if others are used the manufacturer's suggestions should be followed.

Great care must be taken that the grid return leads are exactly as shown. On the R.F. tubes they both are connected to the potentiometer slider; on the detector to the positive "A" battery line and on the A.F. amplifiers to the negative terminal of the filament heating supply.

It should be noted that only three battery leads are necessary; two are for the 6-volt filament battery and the other is the positive plate battery connection. The negative "B" and positive "A" are joined together at their position on the floor or elsewhere. No tap is used for the detector plate as with under 70 volts plate battery the UV-199 works quite well.

The actual layout design may be observed from the photographs and panel drawings. The vacuum tube sockets are arranged in two rows of three each with a spacing of 2⅞ inches from center to center. The R.F. tube sockets are in front, near the tuning condenser and potentiometer; A.F. sockets are in the rear. Both R.F. and A.F. transformers are placed in logical order to permit of short connections. The R.F. transformers are situated between the first and second and the second and third sockets and mounted under the sub panel. The A.F. transformers are secured directly beneath the A.F. tube sockets.

The variable condenser and potentiometer are mounted on the subpanel so all connections may be made before the front panel is attached. This is very advantageous from a manufacturing standpoint as the entire assembly is firmly arranged on one panel and results in a degree of rigidity and strength not usual in multi-tube receivers.

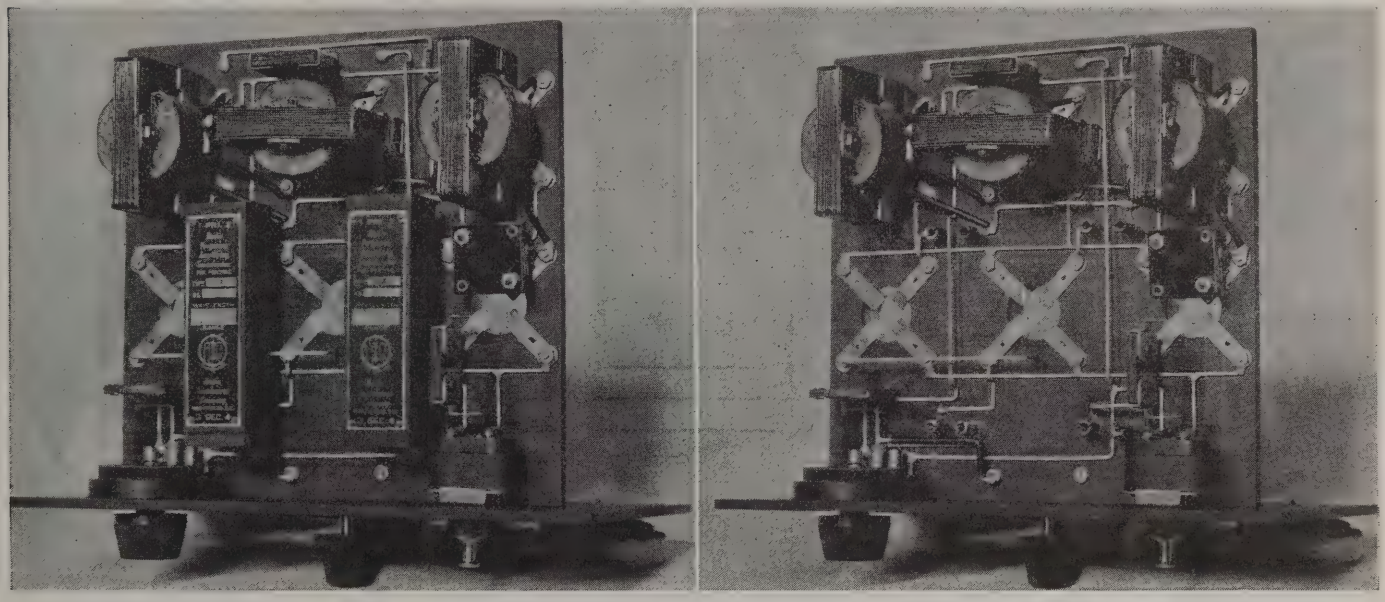
There are only two knobs, the condenser vernier and the potentiometer or volume regulator. The dial is screwed to a collar on the condenser shaft and is used solely as an indicator of wavelength setting. The finish is such as to permit writing on the lower portion with lead pencil or india ink.

It will be noted that there is scarcely an unnecessary piece of equipment and this fact, combined with the exceedingly compact arrangement permits of exceptionally short connections; the wiring is therefore solid and if all spring contacts are made with good phosphor bronze there will seldom, if ever, be need for repair. In addition, insulation of paneling and transformers is good. These two features, i. e., perfect connections and insulation, result in quiet operation.

A point which is frequently neglected in "simplified" receivers is the consistency of wavelength adjustment.

However, it will be observed that ample provisions have been made to retain that factor, to wit: the shunt condenser across the potentiometer slider the fixed filament resistance and the constant value tuning condenser. But still another precaution must be taken—the loop antenna must keep its original inductance value and to do this the wires should be taut, connections short and solid and it must not be moved about too much nor placed too close to large metallic objects.

It would be a good plan to read the constructional details and study the photographs before securing the necessary material. It is needless to say that only the finest components should be selected.



No rheostats on this receiver! Note how very simple the wiring appears in these bottom views. Mounting lugs for the RF transformers are shown in the right hand illustration

EQUIPMENT

One .00025 (250 m-mfd.) variable condenser with a mechanical vernier—that shown is a Veldar—not the regular extra plate type.

One 400-ohm potentiometer; the specified resistance is not essential, but it should be as high as possible. There are very few good wire potentiometers so this item must be selected with care.

Three audio frequency transformers, all low ratio. Those shown are Kardon, unmounted, for UV-199 tubes.

Two radio frequency transformers covering the range of 220-550 meters.

One front panel, 7x10x3/16 inches.

One rear panel, 8x8x¼ inches. The six vacuum tube sockets are "spun" into the sub-panel but, if desired, standard UV-199 sockets may be mounted on top of the panel in the indicated position. It is possible to purchase the sub-panel with spun-in sockets for about $8.00 from the Kardon Products Co.

One battery switch.

One .002 mfd. fixed condenser.

Two .00025 mfd. fixed condensers.

Six lengths of square tinned bus bar.

Two lengths of small black cambric tubing.

Six mounting screws for the variable condenser and potentiometer—usually flat head, 6/32, ½ inch long.

Accessories

One loop. About 3 feet square wound tautly with 12 turns of solid hard drawn No. 20 copper wire spaced ½ inch.

Six UV-199 or C-299 vacuum tubes.

One plate battery of 67½ volts.

One "A" battery of 6 volts.

One loud speaker or a good telephone unit and suitable horn.

Testing

Before using transformers or condensers it is not only advisable but quite essential to test for shorts and breaks; thus faulty equipment may be detected before construction and not only will there be more certainty of perfect operation at the start, but also there will be a saving of time and trouble.

A headset and small 22-volt battery should be connected as shown in figure 3 to provide a testing medium. If the free terminals are touched together for an instant a very strong double click will be heard in the telephone headset; if the terminals are joined through a resistance the clicks will not be as strong, depending upon the value of resistance. If they are applied to an open circuit there will be no definite click.

While wearing the headset the testing terminals should be applied to the primary and secondary connections of both the radio and audio frequency transformers. In each case a strong double click should be heard. If it is not the coil is "open" and the transformer must be replaced. Each transformer should be tested for shorts between windings. This may be done by touching the test terminals to one primary and one secondary connection. If a click is heard, the windings are shorted and the transformer is detective.

In a similar manner, if the test terminals are applied to opposite sets of plates in a condenser, a click indicates a short; lack of a definite click indicates that the condenser is not shorted and should be satisfactory for use. The potentiometer should be tested by touching the test terminals to the ends of the resistance element. A strong click should be heard, otherwise the winding is open.

Remember that all testing may go for naught if the soldering iron is carelessly handled while wiring. In case one is at all doubtful regarding the continuity of a circuit, use the test terminals freely.

There is a comparatively wide variety of insulating panel material to choose from; some are better than others, but on the whole any one of the numerous makes advertised will be entirely satisfactory. When purchasing, specify that the surfaces are to be sanded, blasted or grained and the edges true and square. If the product is "Radion" it is well to retain the original surface.

Discretion must be used in laying out the panels, drawings of which are not shown because the location of holes will vary with different makes of equipment. If one buys all the parts first and then arranges them on the sub-panel there won't be much trouble in this matter. Plenty of space is provided for both the audio and radio frequency transformers. The only problem which may arise will be with the sockets. Those shown are "spun-in" by a process too difficult for home duplication.

If the sub-panel is not purchased with the sockets in place, regular UV-199 sockets may be secured to the sub-panel. They may be mounted on top or on bottom with only the shells jutting through.

In drilling, clamp the panel to the bench in order to have both hands free in working and guiding the drill. Go through steadily but do not "push" as the outer surface may chip. The front panel need not be drilled until the rear panel equipment is assembled and wired.

Assembly

First, the sockets, using either method of the two described. Make sure that the springs are secure and will not move out of place. The three front sockets are fixed with the slots

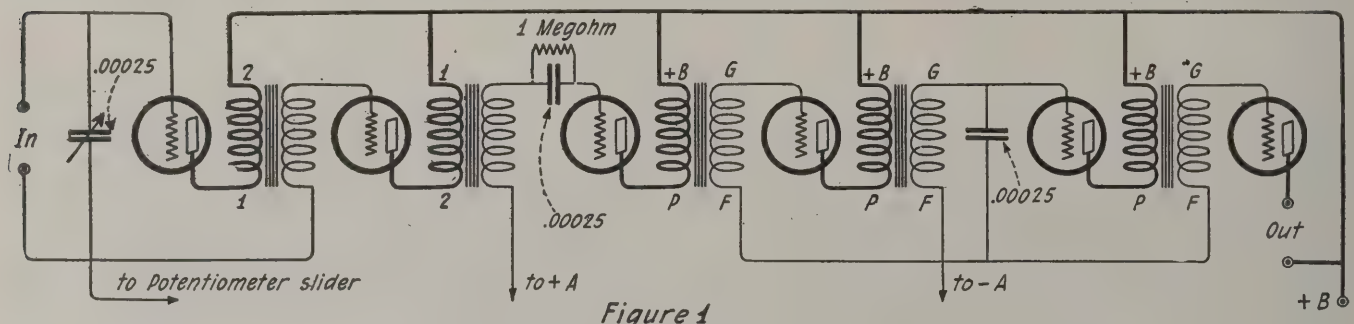


Figure 1

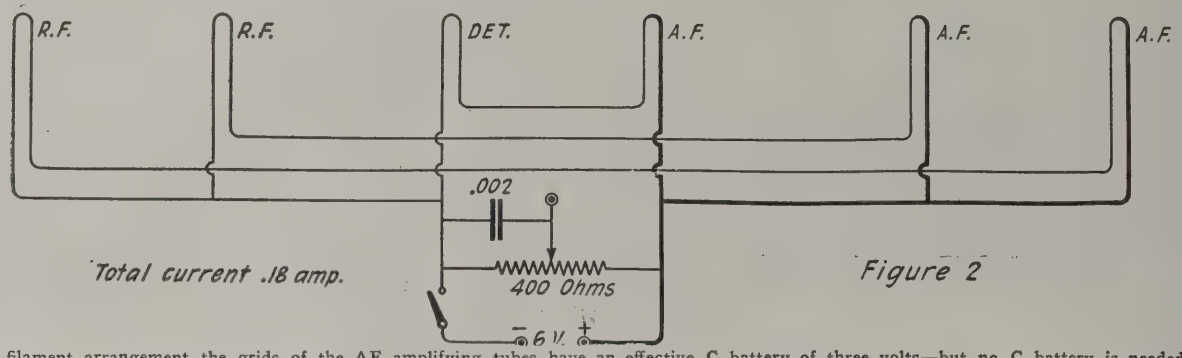


Figure 2

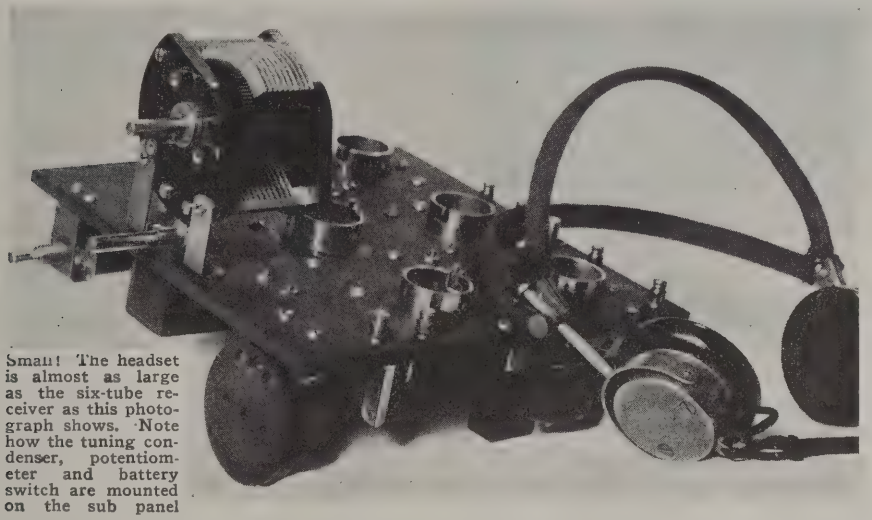
By a special filament arrangement the grids of the AF amplifying tubes have an effective C battery of three volts—but no C battery is needed! Complete dope about this in the text

toward the rear and the back sockets with the slots toward the front.

Then screw in the mounting jacks for the radio frequency transformers. Next the audio frequency transformers under the tube sockets and finally attach the variable condenser and potentiometer to the upper side of the sub-panel.

Wiring

Bus bar wire should be stretched before using as this gives additional rigidity to the wiring and permits of a very neat job, free from the curls and twists in unstretched wire. The usual method of stretching is to place one end of the wire in a vise and with a pair of pliers clamping the other end, pull with sufficient force to extend the bus bar a small fraction of an inch per foot.



Small! The headset is almost as large as the six-tube receiver as this photograph shows. Note how the tuning condenser, potentiometer and battery switch are mounted on the sub panel

For details of soldering and wiring we reprint here seven points extracted from another and previous article of ours:

1—Solder all joints. Soldering to a lug and screwing the lug to a terminal does not constitute a soldered joint—the wire should be soldered direct to the terminal.

2—Flow the solder in all joints so they are perfectly smooth when cold. This requires a properly heated and tinned iron with sufficient flux.

3—Do not be too sparing in the use of flux, but immediately after soldering remove all traces of paste—with scrupulous care.

4—Use square tinned bus bar wire wherever possible.

5—Make 90° bends and run stiff connections only vertically and horizontally.

6—Wires more than a few inches in length should be run against the panel or other insulating support — they should not be left unprotected in space.

7—When soldering a wire to a terminal, aim the wire toward the center of the terminal—do not solder it to the side.

The filament circuit should be wired first in exact accordance with the diagram, figure 2. Starting at the negative filament battery terminal run a bus bar to one point on the battery switch; from the other point to the left hand (from front) terminal of the potentiometer and thence to one filament spring contact of each of the first three tubes (R.F. and detector). From the positive filament battery terminal run a bus bar to the other end of the potentiometer resistance to one filament spring contact of each of the last three sockets. Join the remaining filament contacts of the first and last tube; of the second and fifth; and the third and fourth. Note that this is quite simple as the sockets are arranged perfectly; the third A.F. is directly behind the first R.F., the second A.F. in back of the second R.F. and the first A.F. socket in the rear of the detector socket. Check over the wiring a number of times and then test by applying a six-volt battery to the binding posts and inserting a pair of tubes in their sockets. They should light when the switch is on. Test with all six tubes in the sockets; if two or more fail to light the trouble is due to one of the following details:

(a) Defective tube.

(b) Poor contact between the socket springs and the tube studs.

(c) Wrong wiring due to mistakes in socket spring connections—the UV-199 has filament contacts opposite.

(d) Broken circuit. A joint which seems to be soldered may not be making good connection.

The remedy in each case is obvious and indeed the circuit is of such simplicity that we doubt if anyone will have any trouble, provided of course that he is reasonably careful.

In wiring the rest of the circuit consider the plate and guide connections as separate and distinct and finish one entirely before starting the other.

Beginning at the positive plate battery binding post run a bus bar to terminal 2 of the second R.F. transformer and to terminal 1 of the first R.F. transformer. To this bus bar connect the flexible positive B leads of the primaries of the audio frequency transformers—running these leads in cambric tubing to avoid accidental shorts. Also connect this bus to one binding post of the out-put terminals. Then connect the plate springs of all six sockets to their respective primaries.

The grid-filament circuit is shown in figure 1, represented in light lines; it is self-explanatory.

As the final step connect the fixed .002 mfd. condenser between the slider and the negative terminal of the potentiometer. Check over the wiring at least three times and of course correct any errors. Also make certain that adjacent wires are not touching each other and take care in future handling to prevent this.

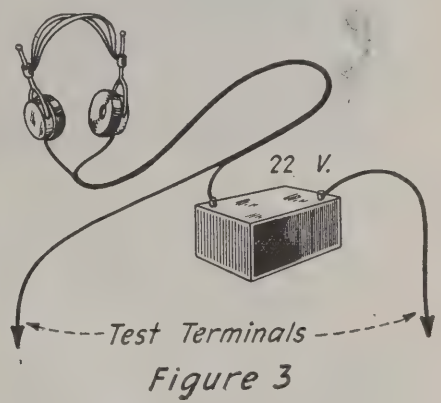


Figure 3. All the material for the "W. A. Uni-Control" is tested before being used. A simple testing outfit is shown above

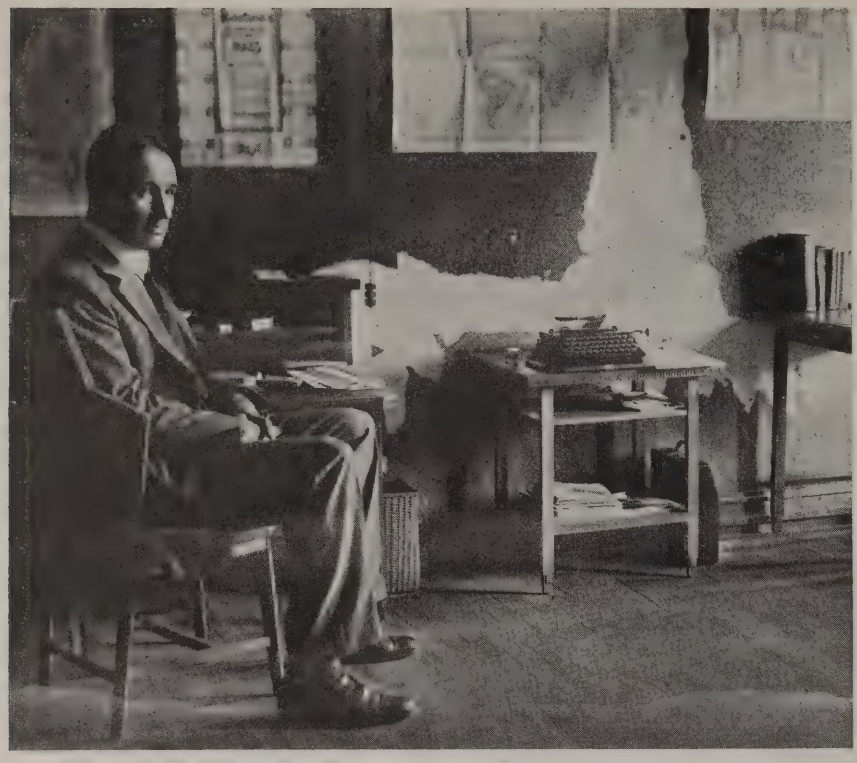
Finishing and Testing

Attach the front panel to its condenser; no special brackets are necessary. Adjust the condenser vernier and potentiometer so both operate smoothly and finally attach a suitable collar to the condenser shaft and screw the dial to the collar, arranging both so that when the 0° mark on the dial coincides with the top indicator the movable plates are all "out."

Insert the grid leak and R.F. transformers in their respective mountings. All these connections should be stiff and positive.

Next, connect the plate and filament batteries, the loop and the loud speaker. Insert tubes in two sockets—say the first and last—and push the switch "on." If the tubes light with their

(*Continued on page* 64)



Col. Samuel Reber, RCA representative in Japan

How Iwaki Told the World

(*Continued from page* 18)

and Shimotsui in the Inland Sea west of Osaka.

I had just visited Tomioka to present to Mr. Yonemura and his staff the generous bonus which the Radio Corporation donated to them with the consent of the Minister of Communications in recognition of their initiative and their resourcefulness during the first days of the crisis. With considerable reluctance, as he is very modest, Mr. Yonemura told me the following story which I have set down as best I can from memory and a few notes I made during its narration. I am also adding his letter to me in response to my request to write me his story. The letter was written before my visit to Tomioka.

YONEMURA'S OWN STORY

"At twelve o'clock on the first of September, we had the most severe shock I have ever felt. As soon as it was over, I tested the land wires and found the circuit to Haranomachi O. K. but all other lines down. I realized at once that the only way we could get anything was by radio and I kept a close watch for anything that might be sent from any station and at about seven o'clock that evening I heard Choshi calling both Shiomiasaki and Shimotsui, trying to send an official message from the Chief of Police of Yokohama to the Governor of Osaka. This message had been sent by radio from the Corea Maru which was then in the harbor of Yokohama to the Choshi station. I have read in the newspapers that the Chief of Police at three o'clock that afternoon, when, in spite of his official position, he was unable to get even a sampan, jumped into the harbor and swam to the Corea Maru to send his report. On reaching the vessel, he collapsed but, as soon as he was revived, wrote his report and gave it to the radio operator who succeeded in getting it through to Choshi. I copied this report and sent it at once to my superiors at Sendai over a temporary wire which had just been brought in. I then sent the first bulletin to Honolulu. The report to Sendai was the first news that the officials there had of the earthquake and from what I have heard from America and what you have told me, I now know that radio beat the cable, as it always can. I then continued sending whatever reliable news I could get from any source until the foreign correspondents resumed their news service on the seventh of September.

"I began trying to raise Funabashi on the morning of the second and continued until the afternoon of the fourth when Funabashi answered and began sending me official messages for the United States and Europe. The first message for the Secretary of State at Washington was received at 3:30 p. m., September 4th, and the second, at 11:55 a. m. on the fifth. The one addressed to the Commanding General of the Philippine Division arrived at 7:34 p. m. of the sixth and was relayed by Pearl Harbor to Cavite. Funabashi also sent me press copy for the Associated Press, the United Press and the Philadelphia Ledger.

IN MR. YONEMURA'S OWN WORDS

Iwaki Radio Station,
Oct. 6, 1923.

My dear Mr. Reber:

Many thanks for your letter and the eulogy expressed therein on my little service on the occasion of the great disaster.

Immediately after a rather strong earthquake shock at Tomioka at noon, September 1, we found that the wires to Tokyo and Yokohama were down and telegraphic communication with both cities was entirely stopped. I foresaw the difficulty of bringing about restoration of the telegraphic circuits, and it came to my mind that we must open up connection with other radio stations, because radio is the only means of communication in such an emergency. Therefore we at once began calling up our fellow stations and listening in for them.

At 7 p. m. on that afternoon, we picked up Choshi Radio relaying messages reporting on the disaster in Yokohama. This was the first news, sent by the Korea Maru, then in the port of Yokohama. This message and subsequently others were one after another retransmitted to our Head Office, Sendai, by a temporary wire connection.

In view of the fact that Tokyo was deprived of all means of communication with the outside world as a result of the interruption of the Bonin cable and the land lines, I saw the necessity of sending out the news to the world by our own radio. On the night of the first I sent to Honolulu the first news which reads as follows:

> "Conflagration subsequent to severe earthquake at Yokohama at noon today whole city practically ablaze with numerous casualties all traffic stopped."

The message was relayed to San Francisco at once and delivered to various papers there. It is said that the papers throughout the United States issued extras on the morning of the first or some time during that day giving the above account of the disaster. I was greeted with universal applause by the papers, some of which called me "Radio Hero" and published my picture. For some days after that, I continued sending news several times each day. These bulletins were copied direct by San Francisco Radio, which maintained a constant watch for us.

My work came to an end on the seventh, for we then saw press messages from foreign correspondents going through Iwaki.

Thanking you again for your kindness, I am,

Sincerely yours,

K. Yonemura

What to Do Until the Doctor Comes

By R. L. Duncan

THE vast number of radio enthusiasts, past, present and future, may be divided into two classes: One, the non-technical, interested solely in the satisfactory and consistent performance of their "radio" and not caring how and why it operates; and the other the "bug" possessing, or desirous of possessing, a knowledge of everything concerning his apparatus from aerial to ground.

The former class is representative of Mr. Black and Mr. Brown. Mr. Black, having secured his receiving set inquired of his next door neighbor, Mr. Brown, if he could inform him why last night's program was received in spite of the fact that he was using no ground connection while the directions specifically stated that a ground should be used. Mr. Brown's only answer was, "Don't ask me, Mr. Black, I don't even know why we receive the programs with all the wires connected."

For just such people as Mr. Black and Mr. Brown this article is written. For there comes a time when trouble is experienced even with the finest of receivers and if the owner knows nothing about the set he will have to forego the pleasure of broadcasting until an expert can be called in to "doctor" the outfit. Now usually—or at least in the great majority of instances the writer has observed—when the receiver is of reliable manufacture the "faults" that develop are of minor character and most easily remedied. Of course it is only natural that the non-technical owner should consider even the smallest part as being a bit too much for him to tinker with. But on the other hand it is always well to know something about the more common difficulties, not only because they are prone to come up at the most inopportune moment when some especially interesting event is to be broadcasted, but also in order to estimate the nature of the trouble and guard against similar occurrences in the future.

The few tests and expedients which follow, therefore, are set down for Mr. Everyman to enable him to correct by himself any of the numerous minor "troubles" that might cause his set to function poorly or cease working altogether.

What's the Matter?

When the receiving equipment is composed of good material throughout and has been working well, but for some reason ceases to "percolate" as it should, we must find the trouble and then correct it. We know that the latter is the easier of the two; it is placing a finger on the actual fault that presents the harder job, but that shouldn't daunt one, for it's easy, when one knows how.

Happily a well made receiver may be depended on for exceptionally long service without repairs of any kind. It is very seldom that wire connections jar loose or break as modern construction is far from being delicate and the makers vie with each other in producing mechanical and electrical features of durability. The one point of inherent weakness is that of spring connections such as are encountered in plug mountings, tube sockets and leak holders. Otherwise the receiver itself is seldom at fault; usually failure of operation may be traced to the batteries, tubes and their connections.

Before you call in the radio doctor find out if the trouble with your receiver isn't located in the answer to one of these queries:

1. **Are the tubes making proper contact in their socket?**
2. **Are the battery and other leads in good shape?**
3. **Are the binding posts on the receiver and other equipment tightened up?**
4. **Are all the vacuum tubes good?**
5. **Are the A battery leads reversed?**
6. **Is the A or B battery run down?**

We have three distinct but naturally interlinking subjects to consider: Connections, batteries and tubes. And if we follow a definite procedure, checking each subject in turn and conducting a systematic, but still simple search, we are bound to find "what's the matter?"

We will take up the more important first, but the correlation is such that all three are essential to a good working knowledge of simplified trouble shooting.

Connections — Broken, Bad, Wrong and Indifferent

Under one of these heads must come the description of a connection that is not electrically good.

When the receiver does not operate properly remove all the vacuum tubes and, with a lead pencil or similar object lift up each leaf spring in the tube socket so that when the V.T. is replaced there will be a noticeable and fairly heavy tension against the tube pins. Also, when replacing, twist them back and forth in the slot so that the friction will scrape both the springs and tube pins and assure a clean contact. This cleaning process should not be deferred only until the receiver stops working, but is also a good thing to do from time to time in order to safeguard against the possibility of poor contact. Then, if there are other spring connections, bend them to make positive and firm contact. Also tighten the binding posts on the receiver, batteries and other auxiliary equipment. The B battery terminals are especially apt to loosen so it would be well to go over them and be sure they are clamped securely, using a pair of pliers if necessary.

A loose connection in the B battery circuit will be characterized by a sharply defined crackling noise. And if an inspection of this section does not reveal an apparent break despite continued crackling, the B battery may be defective—this will be taken up under the subject of batteries.

Inspect carefully all wire connections leading to the batteries and output: If any are not in A-1 condition, replace them.

Also pay careful attention to the aerial and ground connections: Be sure that all antenna joints are soldered and that no accidental shorts (that is—direct connection between aerial and ground) exist. The antenna should not be permitted to sway into contact with other objects.

If the receiver is totally inoperative and a search for poor connections does not result in a material change, look to the vacuum tubes.

Vacuum Tubes—Burnt Out and Old

Do they glow or light at their usual brilliancy when the filament controls (rheostats, switches and jacks) are manipulated in accordance with the manufacturer's instructions? Or do they fail to light at all? In the latter event, presupposing that the batteries are good, the tube may be burned out. Try switching the tubes, if the receiver is of the multi-tube type, in order that it may be definitely established whether any particular tube is really "blown."

There is no permanent remedy for a "dead" tube—a new one is the only solution—and beware of "bootleg" stuff for usually it is as insidious as its namesake.

Unfortunately a tube may be a "dud" although the filament lights as usual; this is especially true of the low filament current type; being merely a case of "wearing out" in service—that is, the effective life is spent. It is well, therefore to have at least one brand new tube extra both for emergency use and also to check the efficiency of old tubes.

Now, with both connections and tubes checked and apparently proved

satisfactory, but if the receiver still does not work as it should, we must next inspect the

BATTERIES—RUN DOWN AND REVERSED

With each vacuum tube receiver there are used two batteries, the A or filament and the B or plate battery. They may be run down or the connections to them reversed; in either case satisfactory operation is improbable. So we must find out whether they are "up to snuff."

It is a very easy matter to inspect the wiring and see that the connections are not reversed—do so; and if, by chance, they are, attach them properly, being careful of course not to cause any "short circuits," that is, not to connect the terminals of either the A or B batteries together.

The A battery is of either the dry or storage cell type and the normal voltage range is from 1.5 to 6 volts, depending upon the type and arrangement of tubes. The B battery is usually of the dry cell type though of late the storage B battery has become quite popular with those who do not mind the initial cost and have facilities for recharging. The B voltage ranges from 22.5 to 120 volts depending upon the kind of set, etc. The manufacturer generally specifies the proper values and his responsibility ends there. It is up to the owner to keep the batteries in good condition—how can we?

Well, the easiest, quickest and most positive way is to take a voltmeter reading of both and see that they register between 75 per cent. and 100 per cent. of the correct value. If it falls below 75 per cent. the battery should be discarded, or recharged, if it be of the storage type.

If possible a voltmeter should be secured as the action is certain. However, the majority of us do not possess a voltmeter and some other method must be used instead.

First we can judge the length of time we have been using the batteries and by a simple calculation of the type and number of tubes estimate the condition of the cells. We must assume however that the batteries were fresh when purchased and that no defects have cropped up to shorten the effective life.

Suppose we use the receiver three hours a day for six days a week and are interested in knowing how long the filament battery will last before a new one must be substituted. We can consider the ampere hour capacity of a standard cell as being 25 ampere-hours when drained by a dry cell tube such as the WD-11 or WD-12. With a UV-199 or C-299 we may safely consider the ampere-hour capacity as 30. Therefore we should be able to use a dry cell for about 100 hours with a WD tube and about 500 hours with a UV-199 or C-299. The A battery (if standard dry cells) should last about a month or six weeks with a WD tube and almost 3 or 4 months with one UV-199.

Naturally if more tubes are used without increasing the number of cells in any way the effective battery life will be cut in half or reduced to a third, depending on whether one or two tubes are added. It is usually best with WD tubes to add another cell in parallel for each tube and keep the effective life the same as with one tube and one cell. This system of parallel connections is quite popular with the RC receivers using WD-12 tubes throughout and the three cells should last about a month or more.

The B battery should always be of the large size as the miniature affairs depreciate in value much too quickly for any service other than where quite necessary for portable service. The large size will last about five months with one or two tubes and an average of four months with three tubes.

These figures are very rough approximations as the life is also dependent upon the voltage of the B battery, the type of tubes and the proximity to broadcasting stations—for an increase in signal intensity is not solely made up by the received energy, the B battery supplies most and consequently drops off more quickly when all reception is from distant points.

Storage A and B batteries may be recharged, the duration of a charge being dependent upon the ampere hour capacity and the type and number of tubes which they supply.

The storage batteries' service may also be calculated, but it is much better to make positive tests with a hydrometer syringe. (Note, however, that all storage B batteries do not have the same density of electrolyte so the following list may not be applicable to them.)

Hydrometer Reading	*Battery Condition*
1.280 to 1.300	Fully charged
1.175 to 1.200	Half charged
1.1 or less	Discharged

Make frequent hydrometer readings for only through use of a good battery are we able to secure the most from our receiver.

Keep the A and B batteries, whether they be dry or storage cell type, in the best condition. Make certain that all connections to them are proper and before blaming the receiver, look at the batteries.

If so far it has not been possible to make the outfit "kick over" properly—why, now is the time to get in the "doctor" with his tool kit and expert knowledge.

Amateur Activities

MILWAUKEE delegates reporting on the Second National American Radio Relay League Convention, held in Chicago, was the principal feature at the season's opening meeting of the Milwaukee Radio Amateurs' Club, Inc. Next was held the annual corporate meeting at which seven directors and one vice-director were elected, who, in turn, appointed the society's five general officers and seven standing committee chairmen. The directors, all prominent Milwaukee radio amateurs, are C. N. Crapo, 9VD, the A. R. R. L.'s local District Superintendent; D. W. Gellerup, 9AOE; E. T. Howell, Sc. M., 9CVI; M. F. Szukalski, Jr., 9AAP; E. A. Cary, 9ATO; F. W. Catel, 9DTK; M. H. Doll, 9ALR, West Allis; and G. F. Metcalf, 9CKW, Wauwatosa. The officers are E. T. Howell, president; M. F. Szukalski, Jr., vice-president; C. S. Polacheck, secretary; E. W. Ruppenthal, 9AYA, treasurer; L. S. Hillegas-Baird, business manager; F. W. Catel, assistant treasurer. The committee chairmen are: L. J. Topolinski, general counsel; publications, H. G. Fawcett; technical, D. W. Gellerup; membership, F. W. Catel; program, E. T. Howell; publicity, L. S. Hillegas-Baird; and traffic, C. N. Crapo.

At the annual meeting the out-going officers reported a steady growth in membership and an increase in scope of activities. However, the annual membership drive has been launched, and it is hoped that the total number of members will reach two-hundred before the season closes. The West Allis Radio Club, a suburban society, has been dissolved and its members are joining the Milwaukee club.

The committees are all in action. The technical one remains a leader, recently giving an interesting report entitled "C. W. Transmitter Circuits." Many lectures by well-known radio men are being arranged by the program committee. Two have already been given; they were "The New Tatalum Chemical Rectifier," by H. L. Olesen, 9CSR, and "Vacuum Tube Characteristics," by J. H. Miller, Electrical Engineer.

Interest in radio continues to increase in Denmark, and it is estimated that there are now approximately 10,000 radio amateurs in Denmark.

Footing the Broadcasting Bill

(*Continued from page 27*)

listeners that they should pay something, somehow, for radio entertainment. It is generally realized by now that the present situation is unsound and unfair, and that radio broadcasting will be firmly established only after some definite means of financial support has been inaugurated.

WHO SHALL PAY—LISTENER OR BROADCASTER?

How can the broadcaster derive revenue for his services? That is the question before us today. To begin with, there are two broad sources of revenue: first, collecting from the listener, either directly or indirectly, as will be outlined in what follows; secondly, collecting from seekers of publicity, at the microphone end.

The first idea which comes to mind, under the heading of collecting from the listener, is some sort of Government control and licensing arrangement, whereby receiving sets must pay an annual tax so as to derive revenue for the broadcasters. In this instance we have a precedent to fall back on. In Great Britain, the broadcasting situation is developing along quite different lines from ours. To avoid the very troubles into which we have fallen, the Britishers evolved a Government licensing system which compels—or tries to compel, rather—every user of a radio receiving set to obtain a yearly license. The Government collects the license fees and, after defraying the costs of administration, turns over a goodly portion of the funds to a broadcasting organization. Furthermore, radio manufacturing is more or less of a domestic monopoly, so that the broadcasters are assured that their efforts are not being wasted on promoting the business of rivals, especially foreign competitors.

This Government licensing system is beautiful as a theory, but somehow or other it breaks down in practice. According to reports, it has not been a brilliant success in Great Britain. Many receiving sets are operated without licenses, and there is considerable ill feeling on the part of the British public as they view the freedom enjoyed by the citizens of other countries.

Such a method of defraying the costs of broadcasting would be a very lame proposition in these United States. It would be highly resented. It would work a grave injury to the radio industry. The Government costs of administering a licensing system for receiving sets and collecting the fees might well be such as to leave very little for the broadcasters, thus defeating the very object of such a move. And then, too, we have enjoyed radio freedom long enough to protest violently at Government interference. While it may be a simple matter to check up on transmitters, when it comes to receiving sets it is necessary to count largely on the conscience of the user, so far as a license is concerned. It would be the Eighteenth Amendment all over again!

High grade programs as vehicles for publicity

From this improbable method we turn to an indirect means of collecting from the listeners. How about taxing the manufacturers and dealers in radio equipment? Surely broadcasting is the very foundation upon which they build their business, and they should pay their due share towards insuring that foundation. It is estimated that if the manufacturers and dealers were to pay their proportionate share of the expenses connected with the operation of a first-class group of broadcasting stations covering the entire country, the cost to them would be but a fraction of one per cent. of their yearly turnover. One association of electrical jobbers and dealers has figured this broadcast contribution at 1/10 per cent. of the yearly turnover.

It goes without saying that all manufacturers and dealers could not be depended upon to pay their due share to the broadcasting fund. There would be shirkers, sure enough. So in connection with such a plan it might be advisable to introduce a distinctive label to be placed on all apparatus manufactured or sold by members of the broadcasting association, so that buyers with the American spirit of fair play would give preference to wares morally entitled to broadcasting rights. In this manner it would be possible to differentiate between the parasitic and irresponsible manufacturers and dealers who would not contribute towards broadcasting activities, and manufacturers and dealers who were responsible for broadcasting entertainment. Such an arrangement would add no further burden to the radio buyer, yet it would relieve him of all further obligations to the broadcasters, since the radio entertainment would be paid for by him, indirectly.

THE PAY-AS-YOU-ENTER IDEA IN RADIO

Anyone who has endeavored to arouse an association of manufacturers and dealers into paying for something or other must realize the gigantic task ahead of that Napoleon of the radio industry who may collect from the radio manufacturers and dealers. The plan has been formulated quite a while back. It has been discussed. It has been urged upon the radio industry. And still, nothing is done. Broadcasting seems so well established at present that no one seems to be willing to bother with it. And then it's free, so why pay for it?

Perhaps a more likely arrangement would be the pay-as-you-enter plan, whereby the purchaser of radio equipment would pay a very small percentage toward the general broadcasting fund at the time the sale was consummated. This collection might either take the form of a slight increase in the cost of radio equipment, or as an additional sum of fixed percentage. The main difficulty here, no doubt, would again be the old story of the radio parasites, who thrive on radio broadcasting without ever contributing a single thing toward it. No doubt these parasites would appeal to a certain kind of trade by not collecting a broadcasting tax, thus offering radio equipment at lower prices, as they do at present.

Therefore, we must cast about for some radio article which is controlled by responsible manufacturers and suffers no competition whatsoever. Immediately we think of vacuum tubes. Aside from a handful of "bootleg" tubes which are of little or no account, the manufacture and sale of vacuum tubes is mostly in good hands and is readily controlled. Furthermore, virtually every listener-in uses vacuum tubes, not only as part of the original installation, but also as renewals from time to time.

The vacuum tube offers an excellent means of collecting funds for broadcasting. If a small charge of 50 cents were collected on every vacuum tube sold, the total amount of money thus raised would exceed one million dollars a year. Inasmuch as there is virtually no competition in the manufacture of vacuum tubes, the manufacturers could readily set a price which would include a broadcasting tax to be passed on to the consumer. Of the various devices for collecting broadcasting revenue, a small tax on each vacuum tube sold appears to be the simplest, most applicable, and—if such a thing is possible—the most favorable from the standpoint of the public.

PASSING THE HAT AROUND

In view of the demand on the part of the radio audience for nothing but the best programs, the broadcasters are finding it increasingly difficult to do their work, especially under the existing gratis-free-for-nothing basis. It has been suggested from time to time that some big-hearted individuals of a decidedly public-spirited turn of mind might well give a little thought to radio. Just as public libraries have been endowed and public concerts have been paid for and other things have been done for the general public, so might radio be supported to the everlasting fame of some far-sighted individual. A moderate sum of money, donated to radio broadcasting, would go a long way. It might serve to secure the greatest artists, the finest orchestras, the leading lecturers, and so on.

So far, nothing has been done along this line, but it seems to be only a matter of time before some wide-awake gentleman of means will see a new way of doing something for the general public. For here is an opportunity of doing something not merely for the inhabitants of a town or city, but of doing something for hundreds of thousands and even millions at one time. By means of radio broadcasting, the philanthropical offer which formerly benefited but a small number of people and a single locality, is now amplified so as to reach the multitudes and spread over a wide area. Retail philanthropy thus becomes wholesale philanthropy.

Let us not leave such a task wholly to kind-hearted individuals of surplus wealth. There is no law against the average individual considering a donation to broadcasting. The time may come when we shall have drives for broadcasting funds. If the radio listeners insist on hearing certain things broadcasted, what is fairer than to have them join in a collection for the purpose of raising the necessary funds to enable the broadcasters to secure the necessary features?

RADIO A LA SCRAMBLED EGGS

Technical progress in radio may yet evolve some simple means of collecting for high-grade programs. It seems only a matter of time when there will be two definite classes of radio broadcasting service—the regular or free service, and the subscriber service. The former is familiar to us now. The latter will make use of some secret method of transmission and reception, such as a wave-scrambling device or wave-changing gear for the transmitter and receiver, so as to preclude anyone from listening-in except a paying subscriber. In this manner it will be possible for the opera house, the lecture bureau, the leading theater, the stock quotation service and others to give a definite program in return for fixed subscription fees. The subscriber, having paid the fee, will receive a complete receiving set with the wave unscrambling device, thus insuring a "seat" in the special entertainments. This method of broadcasting will afford an important source of revenue for various theaters, lecture bureaus, special information purveyors and others, and will become an invaluable by-product to their present efforts. Such a plan is already in effect in the form of "wired wireless."

So much for the collecting of funds from the receiving end of broadcasting. Fully cognizant of the fact that it is difficult to make people pay for something which they have been receiving for nothing, we hasten to turn our thoughts to collecting from the microphone end. We are back again to the matter of publicity and propaganda via radio, and how it can be converted into dollars and cents for defraying the costs of the voices of space.

THE MODERN WAY TO "HIRE A HALL"

It has remained for the great American Telephone and Telegraph Company to evolve a means of making broadcasting economically possible, based on toll broadcasting of publicity talks and features. The original idea of the telephone organization was to operate an out-and-out toll station or a group of such stations, which would be turned over to any company or individual for a fixed charge of so much per minute. In the New York district alone, some one hundred and fifty concerns in the past year have endeavored to purchase radio transmitting equipment for the purpose of broadcasting on their own account, and it goes without saying that if all these stations had been opened up, we would have the story of the Tower of Babel brought up to date.

As it was, these various companies were induced to give up the idea of individual broadcasting stations, and, instead, to make use of the facilities of the American Telephone and Telegraph station known as WEAF. In order to attract a large and attentive audience, this station has developed the highest grade programs which serve as vehicles for a certain amount of publicity features, just as the text columns of any magazine or newspaper serve to attract readers for the advertisers.

Now the publicity features broadcasted through WEAF and, on occasion, through other broadcasting stations of the Bell System, are ingeniously prepared. In the beginning, when the plans of the telephone company were unfolded, it was feared that these publicity features would be bald advertisements, following the technique of the conventional printed advertisement. But to the credit of the telephone company broadcasters, let it be said that the publicity features have been handled in a most interesting and delicate manner, in most instances blending in with the regular program, so as not to detract in the slightest degree from the high quality of the entertainment. Indeed, some of the most interesting talks heard over the radio have been of a publicity nature, and they have been readily received by the public even though the name of the product or the manufacturer has come in for some slight mention some time during the various talks.

Then, too, the Bell System broadcasting stations have been sending out excellent musical programs the cost of which have been defrayed by certain large national advertisers. Surely these advertisers, paying for the use of the station and, in several instances, paying real money for the musicians, are entitled to a brief mention. Banquets and meetings and theatrical performances have been broadcasted, and in many instances these affairs have carried subtle publicity, but always they have been most interesting.

The success of the American Telephone and Telegraph Company has been based on making publicity features of the utmost interest to the listeners, first, last, and always. Rather than let a publicity seeker or advertiser say what he would like to say, they have seen to it that the talk would carry some real message of interest primarily to the listener. Furthermore, they have limited the talks so as to make them just long enough to tell the story, but not too long to bore the audience and lose the listener-interest.

There is no doubt but that the telephone company has pointed out the way to make radio broadcasting economically feasible under the present conditions. After all, it will probably be easier to collect at the transmitter than at the receiving end. Advertisers have not been slow to appreciate the entry of a new publicity medium into the field, and more and more of them are giving considerable thought to broadcasting in preparing their budget of advertising expenditures for the year 1924.

Meanwhile, other broadcasting stations, impressed with the progress made by the Bell System broadcasters, are considering the possibilities of publicity talks. They fully realize that many of their present speakers appear before their microphones for no other purpose than to obtain publicity, and there is no reason why that publicity

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Opportunities in Radio Today

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THE ANNOUNCER
Broadcasting has created a new profession, the radio impresario

their regular engineering courses. I have in mind such institutions as Columbia University, Yale, Harvard, Massachusetts Institute of Technology and the Polytechnic Institute of Brooklyn. The College of the City of New York, although it does not give a straight engineering course leading to a degree has, nevertheless, a well organized and successful course of study in radio engineering. Therefore, a practical way of learning radio properly is to be versed in electrical engineering or at least in electrical principles; then through amateur experimentation or other means acquire enough radio knowledge to become a member in the Engineering Department of one of the large companies and specialize in designing, construction, or research.

Invention takes a prominent place here, for there are still a great many technical problems to be solved in radio. Here again all is not gold that glitters. An engineer of my acquaintance who carefully inspects every radio patent issued by the United States Patent Office, told me that there is but one out of every thousand patents issued that is really of any benefit to radio. The remaining 999 patents he calls "paper patents" that are practically worthless. Incidentally, these "paper patents" reflect the great lack of knowledge and experience on the part of these would-be-inventors. Many of these documents have been prepared by men who have but a vague understanding of radio fundamentals. It would seem, therefore, that if a competent electrical engineer contemplates specializing in radio, the field is wide open to him for fame and recognition providing he is willing to keep close to essentials and present-day needs. There is, of course, the possibility for an electrical man to pursue a strictly electrical career, at the same time using radio as a hobby, for he knows that he may, through due process of experimentation and research, construct something of real importance and benefit to the art.

Manufacturing

This branch offers opportunities to the man of mechanical bent. Today there are hundreds of substantial manufacturing organizations who in turn employ thousands of radio mechanics. Indeed some of the heads of these manufacturing organizations started out in minor positions, such as assemblers, later became shop foremen and finally decided to go into manufacturing on their own. This classification may also include construction, that is to say, the installation of large radio plants at land stations and on board vessels. Since the United States easily leads in radio communication, many installations are sent to Central and South America whereupon experienced and expert construction men are required to do the installing. Repair and service also take a prominent place here. In all the branches of manufacturing and construction there are many opportunities for a career.

Broadcasting

Now we come to perhaps the most popular branch of the radio game. Broadcasting involves many activities some of which I have already covered, such as engineering, manufacturing and construction, but today this branch has become so specialized that it requires specialization in the broadcasting field alone. In addition to this there are, of course, the better known positions such as announcer, studio director, program manager, operator and others. In fact, broadcasting has developed a brand new profession, that of "radio impresario." The tact, initiative and resourcefulness of the radio impresario has done much to make radio broadcasting a favorite form of entertainment for millions, as it is today.

Merchandising

Here indeed is a large and profitable field. Merchandising, as many know, involves several functions known as distribution, servicing, advertising and selling. Each of these sub-divisions are simply alive with opportunities today. They become particularly profitable to men who not only have had this business experience, but who, in addition, know radio. Thus, the salesman who knows radio fundamentals has the jump on the salesman who is simply a salesman. In other

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MERCHANDIZING
The novelty of radio gives the radio salesman a unique advantage, but this does not lessen the necessity that he should be a trained radio man, well equipped to discriminate between well-made and inferior goods

Distortion-Free Amplifiers

By Abraham Ringel
Member, Institute of Radio Engineers

RADIO fans have been so engrossed in the past in receiving, or trying to receive, distant broadcast stations, that they have almost entirely neglected the matter of obtaining good music or understandable speech from their radio sets. The writer does not wish to belittle the receiver that can bring in stations several thousand miles away—it is one of the great advantages of radio over other forms of entertainment. If the radio enthusiast does not care for the program broadcast by the local stations, or if he is particularly interested in a feature put out by a distant station, he can readily tune in the desired station.

It is quite safe to say, however, that most attention is paid to the local broadcasters, and it is strange indeed that the fans should be more interested in freak circuits, so highly advertised, than in securing music that one can enjoy. How many of you readers can really say, after listening to a violin recital over the radio, that you actually seemed to be in the same room with the player? How many of you have listened to people whose voices you were acquainted with? Did you hear the violin itself, or the speaker? Or did you hear something that sounded like a violin, or a voice, rather harsh and strident, that bore some resemblance to that of the speaker? Sad to relate there are many radio sets in use today that reproduce broadcast music and speech with poor quality. This is due partly to the audio frequency amplifier, and partly to the loud speaker used. For the present we will leave out of this discussion the possessors of single-tube receivers who use telephone headsets for listening to the broadcasting. They are very fortunate in that they obtain quality far superior to that of an ordinary amplifier and loud-speaker. Although the purpose of this article is to discuss distortionless amplifiers, it is important to note that the loud-speaker should also be distortionless. There is still room for considerable improvement in loud-speakers. On the other hand, audio frequency amplifiers may be made absolutely perfect through the use of resistance coupling.

In any system which is to reproduce speech or music without distortion, it has been shown by telephone and acoustic engineers that it is necessary to transmit a band of frequencies ranging from about 30 cycles per second to more than 5,000 cycles per second. Certain oscillographic pictures taken by the writer of speech and music as well as many other tests made by him supports this theory. Many notes in various musical instruments are well below 100 or 200 cycles per second, for example, the organ, piano, bass viol and drum. It is these low frequencies, below 400 cycles per second, that gives background so necessary in orchestral or band music. It has been shown in recent tests by telephone engineers that most of the energy in voice sounds, both made and female, is between 250 and 300 cycles per second. The writer has found in his own tests that these low frequencies are required to make speech and music natural. Without them, the quality is undeniably "tinny," the background is gone in music; all the lower notes of the organ, orchestra, or baritone are gone; all speakers appear to have a "down east" twang to their voice. The higher frequencies are required to reproduce the other tones, such as that of violin, flute, saxophone, soprano voice, higher frequencies in the voice sounds. The extremely high frequencies, above 5,000 cycles per second, are necessary to obtain the higher tones of the violin or piccolo, and the consonant sounds, especially the S, F, TH, SH and H, in the human voice.

An audio frequency amplifier must amplify all these frequencies equally well in order that no distortion will take place. If any frequencies are emphasized more than others, these tones will be more prominent in the loud speaking device. Those which are amplified less than others, will be overwhelmed by the rest. This is one of the principal causes of distortion in present-day amplifiers, and as shown above certain portions of speech or music are suppressed and others are over-emphasized. There is another source of distortion in transformer-coupled amplifiers because of the plate

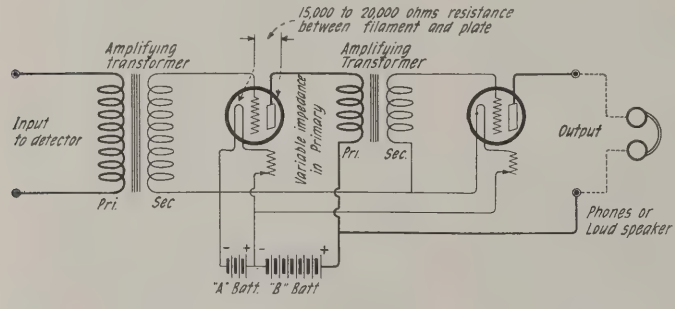


Figure 1. A standard two stage audio frequency amplifier with iron core transformers

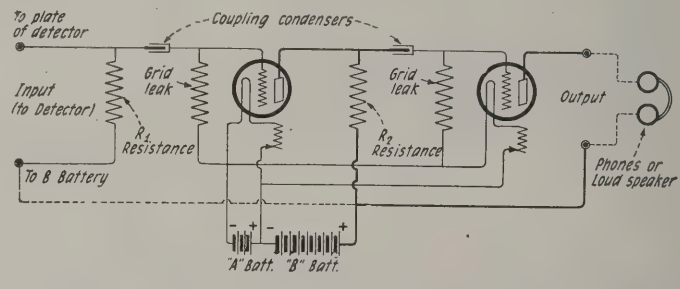


Figure 2. A simple two stage resistance coupled amplifier which, while not giving as much amplification as that shown in figure 1, nevertheless provides distortionless reproduction

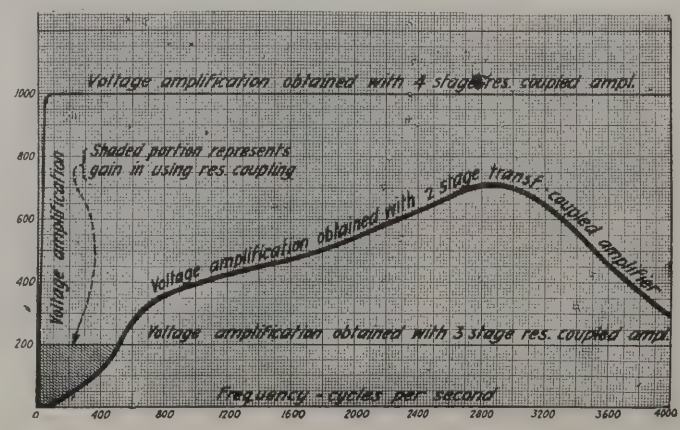


Figure 3. Here is an interesting comparison between the voltage amplification curves of transformer and resistance coupled amplifiers. Note that the latter amplifies all audio frequencies evenly.

current which magnetizes the iron cores of the transformers. This direct current generally sets up a magnetic flux which saturates the core, so that as the current is increased, no additional magnetic flux is produced. Thus, only that portion of the alternating plate current, due to the sound, which decreases the plate current is capable of producing any change in the magnetic flux in the transformer cores. The wave shape of the resulting voltage generated in the secondary of the transformer is thus different from the wave shape of the plate current, which it is supposed to reproduce, since the secondary voltage is determined by the varying magnetization of the core, and this magnetization has a different wave shape than that of the plate current. A remedy for this lies in the use of large amounts of iron so that the core does not become saturated. Existing transformers would hard to say what the varying plate voltage will be. Suffice to say, the resulting distortion is generally enough to make the sound practically unintelligible, assuming that the loud speaker itself is able to handle that amount of energy. This form of distortion would be present in all amplifiers—unreservedly, all amplifiers—unless suitable power tubes were used for the stages handling such voltages. In this connection, it is worth mentioning, only a 50-watt transmitting tube is really capable of efficiently handling a grid voltage of the order of 80 volts at speech frequencies, without distortion.

We have already pointed out how distortion is introduced through saturating the iron cores of transformers and overloading the tubes and transformers with excessive sound currents and voltages. It remains to indicate how unequal response is obtained for different frequencies with amplifying primary of the amplifying transformer to currents of different frequencies. At low frequencies this impedance is only a few thousand ohms and is relatively small compared to the impedance of the tube between filament and plate. The incoming sound currents are applied to the grid of the amplifier tube, and the amplified voltage sets up a current in the plate circuit, which contains the filament to plate resistance and the impedance of the primary winding in series. When the latter impedance is small compared to that of the tube, normally 15,000 to 20,000 ohms, only a small percentage of the amplified voltage will be available across the transformer terminals. If this impedance is large compared to that of the tube, most of the voltage will be available for further amplification. The impedance in an ordinary transformer is generally sufficiently great above 600 cycles so that comparatively little of the

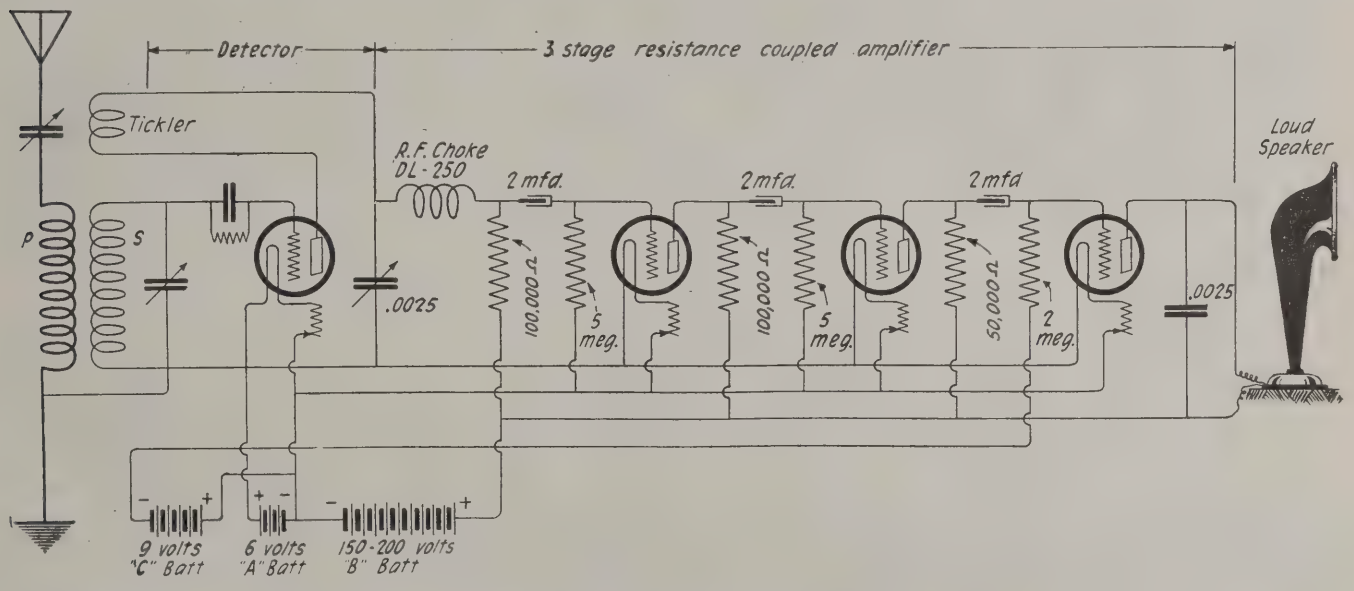


Figure 4. With the circuit shown above it is possible to secure real quality of reproduction—and the price of the parts is no greater than the price of a regular transformer coupled amplifier

have to be tripled in size in order to avoid this distortion. Similar iron distortion is present in amplifiers employing choke coil coupling. This type of distortion is not present in resistance coupled amplifiers, because no iron is used. A somewhat similar type of distortion results when a vacuum tube is overloaded, when the radio fan is so desirous of obtaining noise that he uses three or more stages of amplification, and uses ordinary receiving tubes for the purpose. The ordinary loud speaker requires about 20 volts of varying speech voltage to produce a fairly loud output, and this is usually obtained on local stations with two stages of transformer-coupled amplification. If a third stage is added, with a step-up transformer of say 4 to 1 ratio, we have a voltage of about 80 volts on the grid of the third audio stage. It is transformers and choke coil coupling. Frequencies below 300 cycles per second and above 3,000 cycles per second are very important. The writer has tested several transformer - coupled amplifiers and compared them with resistance-coupled amplifiers at various frequencies, running from extremely low frequencies up to 10,000 and even 20,000 cycles per second. The curve of a two-stage amplifier using transformers of very good quality, as compared with ordinary transformers, is indicated in figure 4. It will be noticed that the amplification is negligible at the low frequencies, rises to a maximum value at about 3,000 cycles per second and then drops again and keeps on falling at the higher frequencies, being practically negligible about 6,000 cycles per second. The cause for this is the varying impedance offered by the amplified plate voltage is wasted in the filament to plate resistance. But below 300 to 400 cycles per second this impedance is so small that most of the voltage is dissipated in the resistance of the tube itself. At high frequencies, the question of the capacity of the windings enters. The secondary usually has some 15,000 or 20,000 odd turns of wire and the capacity is quite large. This capacity when transferred back to the primary side of the transformer is even greater, because of the turns-ratio between primary and secondary. It is shown in all standard transformer theory that the capacity of the secondary is in effect multiplied by the square of the ratio of turns, when considering the capacity transferred to the primary. So that if the ratio of turns is 4 to 1, the secondary capacity acts as if it were a condenser

of 16 times its actual value shunting the primary winding. If the ratio is 10 to 1, the effective capacity is 100 times as great. This gives rise to resonance effects, in some cases of poor transformers. Very sharp peaks are obtained in the neighborhood of 1,000 cycles per second, and while the amplification is large at this point, it is very small at higher frequencies, because the capacity tends to shunt aside these frequencies and they are lost in capacity currents in the condensers formed by the capacity between the various turns of the windings. It is almost impossible to build a transformer that can amplify over a very broad range unless the dimensions of core, etc. are greatly magnified.

from the filament and would soon paralyze the tube. The voltage across the grid is amplified by the action of the vacuum tube and sets up a certain varying current in the plate circuit. If this plate resistance is equal to the external resistance R_2, the voltage amplified in the tube is distributed equally between the two, and half of this voltage is available for further amplification. If the external resistance is seven times as great as that of the tube, the voltage will be seven times that dissipated by the tube, or seven-eighths the entire voltage generated by the tube will be available for use. This will be the same for all frequencies, from the very low frequencies around 20 or 30 cycles up to radio frequencies of about 100,000

plification at the all-important low frequencies, and somewhat less at the frequencies above 600 cycles per second. With four stages of resistance coupling, there is a vast superiority, both in amount of amplification, and uniformity of response over a wide band of frequencies. These curves are illustrated in figure 3. For practical purposes, however, three stages of resistance coupling will give results that are practically as loud as two stages of transformer coupling, and without distortion!

There is one apparent drawback to the use of resistance-coupled amplifiers. We have a resistance of say 100,000 ohms in series with the plate. Allowing a direct current of about 1 milliam-

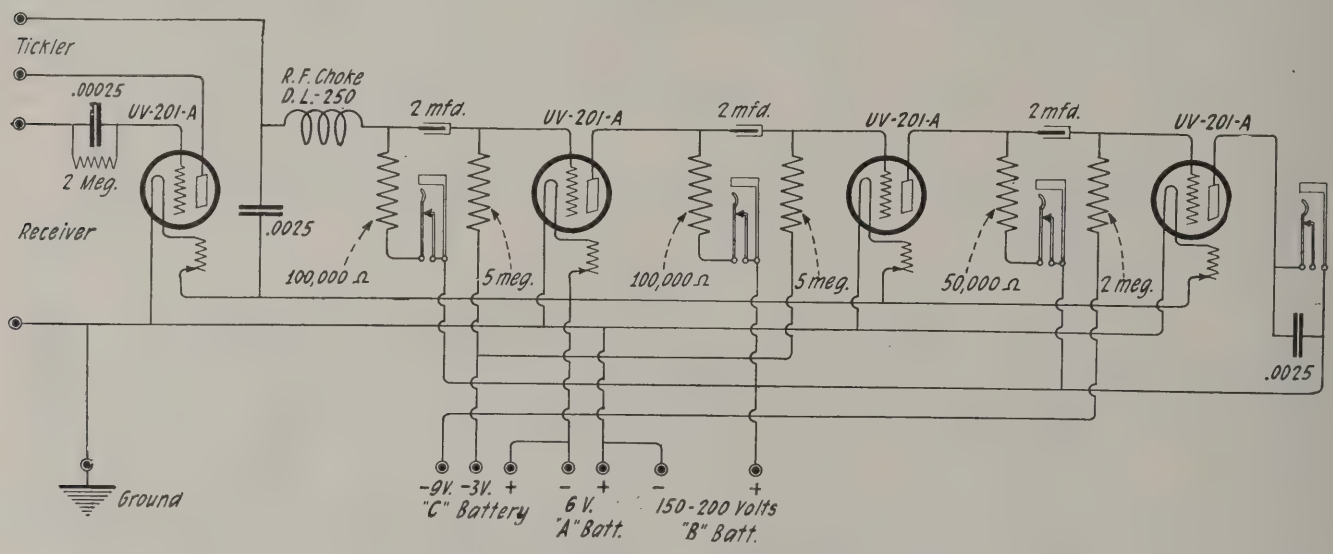


Figure 5. A detector and three stage resistance coupled amplifier. Full details are given in the text

We are thus led to the only very close approach to a distortionless amplifier, viz., the resistance-coupler type. Figure 2 illustrates the essentials of a two-stage resistance-coupler amplifier. The input is connected in the plate circuit of a detector tube and the rectified radio frequency produces a certain audio frequency current in the plate circuit which gives rise to a voltage across the resistance R_1. This resistance cannot be directly connected to the grid of the next tube, since it would make the grid highly positive and thus make the tube inoperative. Connection is made through a condenser of fairly high capacity. A condenser has the faculty of allowing varying currents to pass through, but offers infinitely high impedance to the progress of direct currents. Thus the speech currents, or rather voltage, in R_1 is applied to the grid of the first amplifier tube. A grid leak is shown connecting the grid to the negative side of the filament. If this leak were not present, the grid would acquire a very high negative potential due to the combined action of sound voltage and electron current

cycles. The writer has actually measured the amplification of a resistance-coupled amplifier up to 20,000 cycles without finding any diminution in amplification. This amplification remains constant because the external resistance is not dependent on frequency as is the case with the transformer or choke coil coupling.

There appears to be some myth in circulation, that great amplification cannot be obtained with resistance coupling. True, the amplification obtained with a single stage of resistance coupling is less than that using transformer coupling, but the amplification when using resistance coupling is absolutely the same at all frequencies, and is in fact greater that that of many transformer-coupled types below 100 cycles and above 5,000 cycles. However, it is these lower frequencies that are of vital importance. With two stages of transformer coupling, enough amplification is obtained to give satisfactory intensity of sound from a loud speaker. It requires just one more stage of resistance coupling, i. e., three stages, to give very much greater am-

pere as the plate current, it means that there will be a voltage drop of 100 volts across the external resistance. It is therefore advisable to increase the B-battery to a voltage considerably beyond this value. In actual practice, it is advisable to use B-battery voltages ranging upwards from 150 volts to more than 250 volts. Generally, the higher the voltage used, the better the amplification and the greater amount of energy that can be handled without distortion.

In the past, resistance-coupled amplifiers were more or less noisy, due to various causes. First among these was the lack of a good quiet tube. This trouble is obviated now by using the UV-201-A, or C-301-A, both of which are exceptionally fine tubes, which, because of their good exhaust are absolutely noiseless. The writer has used amplifiers of eight stages containing UV-201-A's and could detect no rushing, hissing, or frying noises so often noticeable in older types of tubes. Doubtless the low filament temperature is also effective in reducing these parasitic effects. Another source of

noise in former years has been the plate resistances, which were generally ordinary carbon rods, whose resistance would vary with the room temperature and humidity of the air. Now there are available excellent resistances for this purpose, namely, the "lavite" type. These resistances are made by the Western Electric Company in various sizes: 38-W = 100,000 ohms, 38-A = 50,000 ohms, 38-B = 12,000 ohms. The coupling condensers, of about two microfarads capacity, should have small leakage. For this purpose the Western Electric condensers, type 21-D, are suitable. The grid leaks are often an exceedingly important factor. Their value may be from 2 to 5 megohms, but should preserve a constant resistance, since any variation in resistance is likely to manifest itself in the form of noise in the output of the amplifier. It is, of course, understood that a reliable make of grid leak should be used here. The writer has obtained best results with the glass enclosed, moisture proof grid leaks. All of the above points are of great importance and the radio fans who intend building these amplifiers should strictly adhere to the equipment mentioned above.

Figure 4 illustrates a three-stage resistance-coupled amplifier connected to a standard regenerative receiver. A feature worthy of note is the radio frequency choke coil connected in series with the plate resistance and the .0025 blocking condenser shunting the two. The purpose of this is to prevent any of the radio frequency from getting into the amplifier. This amplifier is quite capable of amplifying these frequencies and the experimenter is then likely to be troubled with radio frequency oscillations in the system. The insertion of the choke coil, an ordinary honeycomb or duo-lateral coil of about 250 turns, and a blocking condenser will do the trick very nicely. The coupling resistances for the first two stages are 100,000 ohms each, and that for the last stage is 50,000 ohms. The condensers are all of 2 microfarads capacity. Best results are obtained with grid leaks of the values indicated. It is generally advisable to connect a .0025 mfd. condenser across the loud speaker as a further precaution against any radio frequency that may be present in the amplifier, although this is not strictly necessary. All tubes should be UV-201-A, or C-301-A. The detector may be a UV-200, or C-300, but it will require some experimenting with the plate voltage to determine the proper working point for good detection. This will probably be somewhere between 130 to 160 volts —the effective voltage on the plate itself will be only about 20 volts. The B-battery voltage should be as large as possible, at least 150 volts, i. e., seven blocks of B-batteries. The larger size batteries are to be preferred because of their longer life. It will be noticed that the grid leaks of the first two amplifier tubes are connected to the negative leg of the filament, and that the filament rheostats are in the negative leads. In this way a slight negative potential, always desirable, is imparted to the grids of these tubes. In the last tube, the grid leak is connected to a C-battery of about 9 volts which is required to prevent the grid from becoming positive when too powerful a sound voltage is produced. Such an arrangement, four tubes in all, will give very satisfactory loud speaker operation.

Figures 5 and 6 show respectively the wiring and lay-out of a practical detector and three-stage resistance-coupled amplifier unit. The unusual feature here is in the method of connecting the jacks in the circuit. They are shown so as to connect the phones on loud speaker in series with the plate resistance. This is preferable to any other method, since then the entire B-battery voltage will not be directly on the plate. The arrangement of apparatus shown in figure 6 is so designed as to make all leads connected to grid and plate extremely short. There will be no trouble at all from howling or squealing if this lay-out is preserved. Needless to say, all parts should be close together in order to keep the connecting wires short and direct. There is no need for shielding the stages, since the system is extremely stable and will not oscillate readily at audio frequencies.

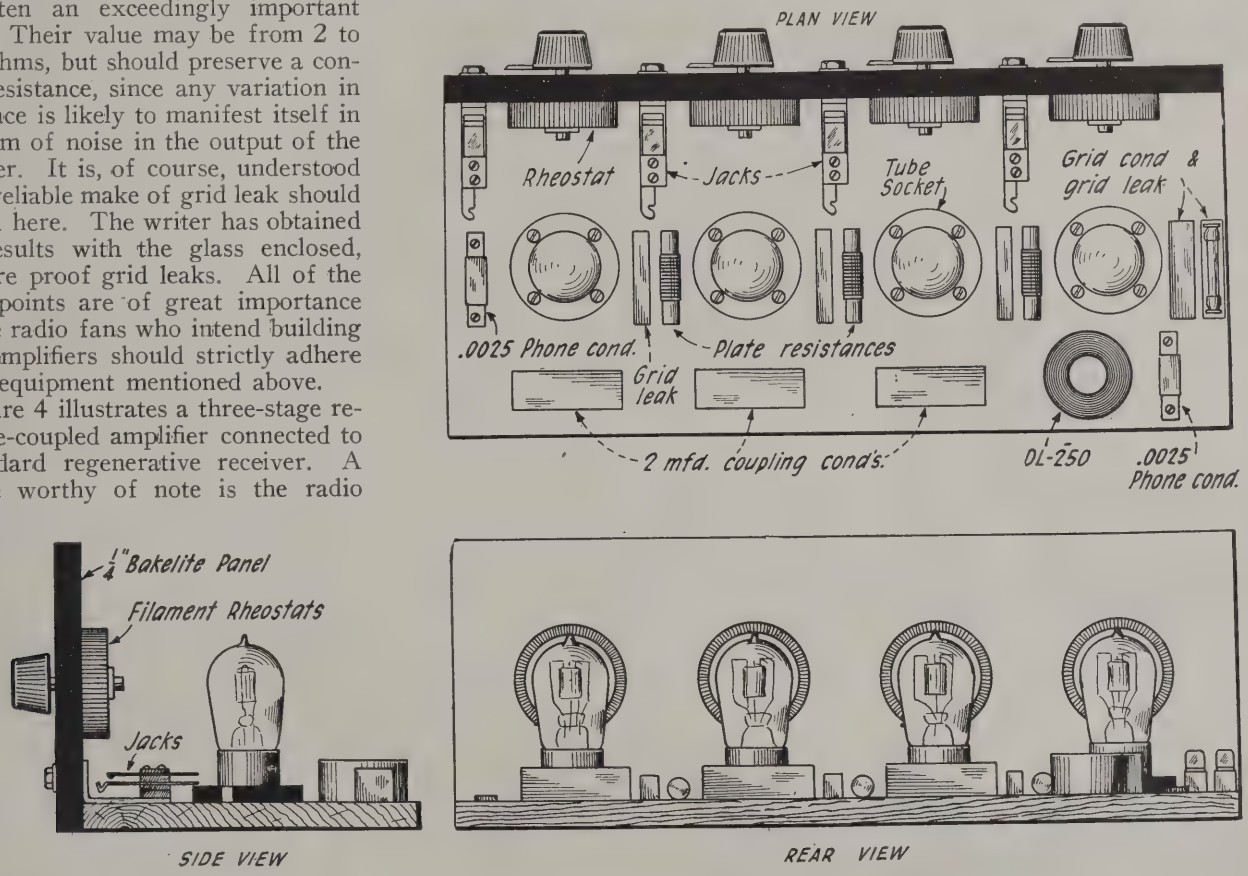


Figure 6. Top, rear and side views of the resistance coupled amplifier

Either wood, bakelite or hard rubber may be used for the panels. In case wood is used, it should be of close grained hard wood, to which two coats of thin shellac or varnish have been applied. This is to prevent the absorption of moisture by the wood, which would be likely to cause noise because of varying leakage resistances.

The quality of speech and music obtained from such an amplifier will be a revelation to the radio fan, especially when used with a good loud speaker, and he will feel well repaid for the labor expended in building the amplifier.

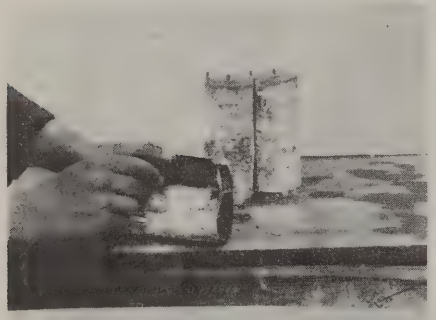
Workshop & Laboratory

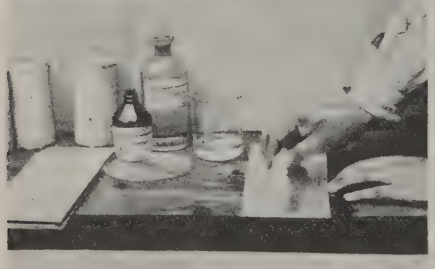
Rejuvenating Dry Cells

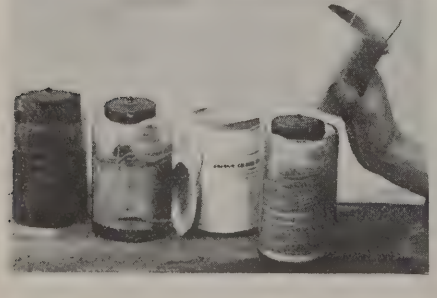
By Dr. E. Bade

WHEN the zinc of a dry cell is eaten out, the cell is usually thrown away and a new one procured. This is not necessary; a well made dry cell of standard make can be made to give twice as much service as it has already given before new ones are required.

When a dry cell goes dead, and the zinc is still good, additional life may be given by punching a few holes in the zinc and placing the battery in a concentrated solution of ammonium chloride. But when the zinc is eaten up, no life can be added by this method. It becomes necessary to make a straight Leclanché cell.







This is accomplished by removing all traces of zinc from the outer wrapper of the dry cell. When the zinc is removed, a cardboard layer will usually be found beneath it; carefully remove it, until the black inner layer of carbon and manganese dioxide is exposed. If it is a cheap make, the paper will be lacking and a cloth wrapper will be found in its place. Do not remove this. The better grades of dry cells will fill the carbon center rod to within ¼ of an inch of the top. Cover the entire carbon and manganese mixture with a piece of cloth and wrap a strong string around it very tightly.

Then take a piece of zinc, which can be obtained in sheets of almost any thickness, and bore a hole near the top after it has been cut into strips just long enough to encircle the carbon cylinder. Into this hole a bolt is passed and a wire is bent around it, then a nut is attached and the bolt and nut tightened. This is the negative pole of the battery.

Pour into an open quart jar a concentrated solution of ammonium chloride, and into this solution place the carbon element. Then the negative element, the zinc ring, is introduced, and the cell is finished. This cell will give, on the average, 1.1 volts. When one volt is to be drawn for a protracted period as in radio tubes, then a number of these cells should be placed in parallel by connecting zinc to zinc and carbon to carbon.

How to Determine the Polarity of a Phone

A FRENCH amateur, J. Libre, of Roubaix, vice-president of the French Northern Radio Club, reports a method of determining the polarity of a phone, now used by all the members of the club. The method is as follows: The phone is placed on a table with cap and diaphragm removed, and a compass is brought sufficiently close to it to produce a deviation in the needle. When the needle has taken its new position in response to the attraction of the magnet in the phone, a current is passed through the windings of the phone. A new movement will be noted in the needle of the compass. If the needle swings still further in the same direction in which it originally was deflected, it is an indication that the current passing through the coils of the phone serves to increase the magnetic field. This is the proper connection. If, on the other hand, passing the current through the phone causes the needle to swing back in the opposite direction, the current is flowing through the coils in the wrong way, neutralizing the effect of the permanent magnets. This is wrong, and tends to weaken the phone.

Alexander Udoff, 16-year-old amateur, builds a miniature Flewelling set. Here's compactness and simplicity!

A Real 100-Volt B Battery

By John W. Brooks

THE plate supply for a receiving set presents a difficult problem to the average amateur as there are but two types of B batteries available —the dry and storage cell batteries; the first is costly and necessitates renewal, while the latter, if made at home, rarely gives the service expected of it. However, the accompanying article offers constructional details of a thoroughly efficient B storage battery, a battery easy to make and low in cost, one that has sufficient ampere hour capacity to obviate recharging over a period of weeks with a number of tubes draining it—and a battery of this type will last for five years with careful handling.

The battery here described consists of one unit containing fifty cells giving 100 volts and is of the lead type. The containers are glass test tubes 1 inch in diameter and 7 inches long, the small plates are cut from regular storage battery plates; the separators are cut from regular battery separators and the connecting lugs are cut from sheet lead. The rack can be made from pieces of wood found lying around any workshop.

A battery containing any number of cells can be made, but if a large battery is desired it is recommended that more than one unit be constructed. If a battery of 24 volts is desired make one containing twelve cells, following the directions given for the larger one. The battery described, furnishing the plate voltage for the set above mentioned, gives a month's service on each charge and is equal in quality to any radio "B" battery that can be purchased. With reasonable care the battery should last at least three years, so considering the cost (about $10.00) it makes a good investment.

For the convenience of the reader and to make the construction as simple as possible the various steps will be classified under separate letters.

Construction

(A) *Plates.* Thirteen positive and thirteen negative storage battery plates, measuring 5 inches high and 5½ inches wide, are necessary. Each plate should be composed of eight grids, counting crosswise. These can be purchased from any battery shop or garage.

The small plates are cut as follows: The plate is laid on a board, the same width as the plate, then another piece of wood is placed on the plate, where the cut is to be made, and clamped firmly to the workbench. A common hack saw is used to do the cutting. The small plates are cut from the larger one as shown in figure 1. The cut should be as near the small lead wire, running lengthwise, as possible. Care should be taken that same is not broken or the plate cracked in any way. Each large plate will give four small ones, and if care is used while cutting not one should be wasted. When handling the small plates they should be placed between two pieces of wood to protect them against breakage.

(B) *Separators.* Eleven storage battery separators are required. These should be as wide as the plate and 1 inch higher.

The small separators are cut from the large one by cutting against the grain with a sharp knife. A steel edge rule should be used to guide the knife. They should be a trifle wider than the plates. Five small separators can be obtained from each large one. Do not use any separators that are cracked or split while cutting.

(C) *Containers.* Fifty glass test tubes are necessary and may be purchased from hardware stores, drug stores or glass company. They should measure 1 inch in diameter by 7 inches long, and can be either round or flat bottomed. If this size cannot be obtained, purchase the next larger size—1⅛ inches by 7 inches.

(D) *Connecting Lugs.* Four pounds

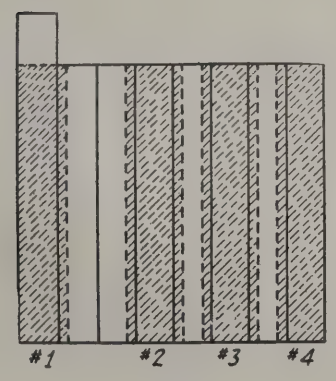


Fig. 1

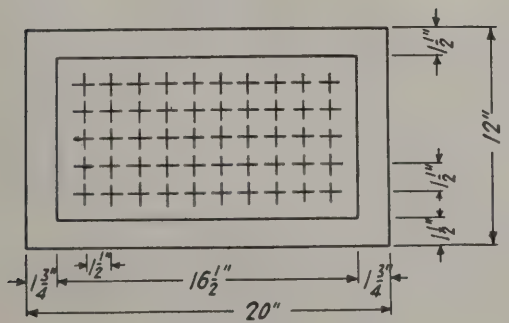


Fig. 2

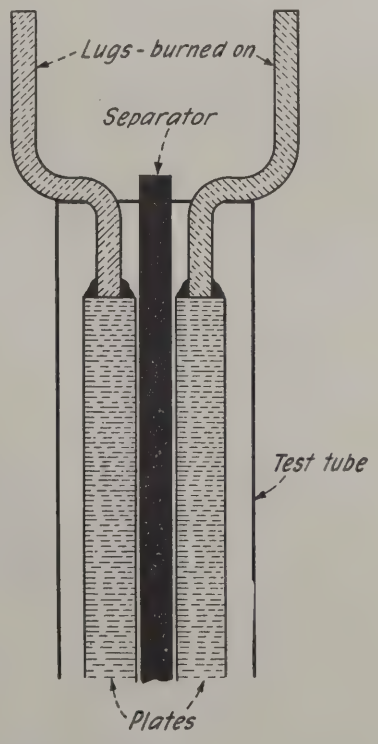


Fig. 3

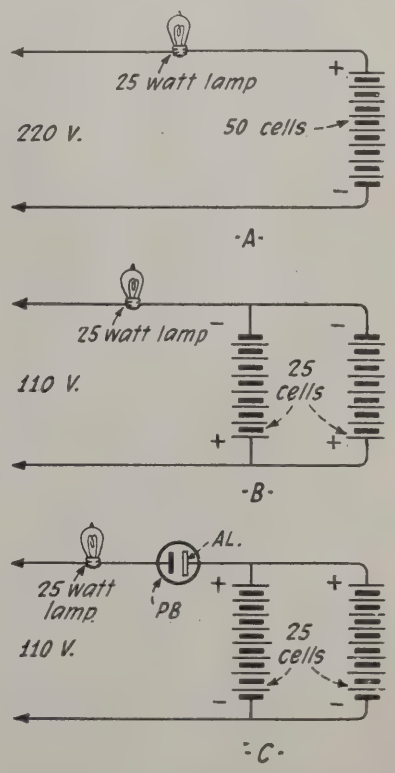


Fig. 4

of sheet lead are used to make the lugs. The thickness of the lead is 1/8 inch, which size comes 7 pounds to the square foot. The lugs are cut 3/16 inch wide and the required length. If it is impossible to obtain sheet lead, large size pure lead wire can be used.

(E) *Solution.* About ½ gallon of 1.300 sulphuric acid solution is required. This can be purchased prepared from a battery shop or garage. The solution for the battery should not have a density over 1.280 (hydrometer reading). A 1.280 solution is obtained by adding distilled water to the 1.300 solution. When adding water test often or the solution may be too weak. About three pints of the solution are required for the first filling.

(F) *Rack.* The material used in constructing the rack consists of 2 boards of white pine or cypress 1 x 12 x 20 inches, and 2 pieces of wood 1 x 1 x 4 inches.

The rack is constructed as follows: With a rule or square measure 1¾ inches from each end, and draw lines across the board, then measure 1½ inches from each side, and draw lines running lengthwise of board—this will give an oblong 9 x 16½ inches. Divide this oblong into squares by drawing five lines lengthwise and ten crosswise. These squares should measure 1½ x 1½ inches as shown in figure 2.

At intersection of lines, holes are drilled, the diameter being the same as the diameter of test tubes. A margin of 1½ inches should be left at each side and each end of board. Do not cut the remaining margin off until all holes are drilled as the board will crack at ends or sides. In the board used for the top of the rack, the holes are drilled all the way through by drilling until the screw point of the drilling emerges from the other side. Turn the board over and drill through. The holes in the base board of the rack are drilled only half way through. The upper part of the rack should be drilled first and used as a template for drilling the base. This saves measuring off both boards. Be sure the bits are sharp or the resulting holes will be rugged. The end pieces are made by cutting diagonally the length of the 1 x 1 inch material. The resulting pieces will be triangular measuring 1 x 1 x 1½ x 4 inches.

The rack is put together by nailing the four triangular pieces on the base board, one at each corner. The upper board is nailed on the other end of the pieces. The edges of the triangular pieces and base board and upper board of rack, should be flush.

The rack can be left unfinished or finished as follows: Dissolve old phonograph records in wood alcohol and apply with brush. Varnish or paint should never be used.

The battery is assembled as follows:

(1) *Preparing Plates.* If full 1 inch (inside diameter) tubes are used two plates and separator will fit tightly in the tube. It will only be necessary to file off rough edges of the plates. If tubes measuring slightly under 1 inch (inside diameter) are used it will be necessary to file the plates to the required size. When filing, the plates should always be placed between two pieces of wood to prevent breakage and care should be taken that the small lead wire is not filed through. A positive and negative plate (with separator between) should be fitted to a certain test tube. Sometimes it is necessary to file the edge on one side of plate more than the other, in order to fit shape of tube. If tubes larger than 1 inch (inside diameter) are used, it will be necessary to file rough edges of plate, assemble positive and negative plate (with separator between), wrap small rubber band around each end and the unit is complete.

(2) *Burning Connecting Lugs to Plates.* The connecting lugs should always be burned to the plate and never soldered. On account of the smallness of lead space on plate, the electrical method of lead burning is most practical. For the burning operation the following material is required: 1 6-volt storage battery; 2 pieces, size No. 18 copper wire 4 or 5 feet long, and about 2 feet of resistance wire, size No. 18.

The heavy lead wire at the upper end of plate is scraped clean. The connecting lugs are bent as shown in figure 3, and both ends scraped clean. The lug should always be burned to the side of the plate toward the oval of the tube.

To burn lug on plate attach the 2 pieces of copper wire to terminals of storage battery. A piece of resistance wire ¾ inch long is cut and bent double. This is twisted, forming an eye at one end, which is attached to one of the copper wires. The resistance wire, after being doubled, should not be over ¼ inch long. The connecting lug is laid on the plate where the connection is to be made. The resistance wire, held with pliers, is touched to the lug at the desired place, and the circuit closed by touching the other copper wire to any part of the lead forming the plate or lug. The resistance heats quickly and will burn away if held on lead too long. The heat can be governed by opening the circuit. The lead of the lug and plate must be heated at the same time, otherwise they will not run together. If the reader is not familiar with this type of lead burning he should practice burning two pieces of lead together before tackling the plates. Extreme care should be taken that the plates are not injured during the burning process.

(3) *Connecting the Cells.* The tubes containing the plates are placed in the rack in the following order: The rows run lengthwise and the positive plate in one cell is connected to the negative plate of the next cell. Care should be taken that 2 positive or negative plates are not connected together. The positive plates are of a dark red color and the negative plates are gray. The lugs are burned together by electricity. The 2 center lugs should not be connected until after charging.

(4) *Adding Solution to Battery.* The tubes are filled to top of separators with the 1.280 sulphuric acid solution, and the battery is allowed to stand for 8 hours. It will then be necessary to bring it up to the level again and let battery stand for 4 hours. After the battery has stood 12 hours it is ready for charging. Do not add acid after second filling; level is maintained by adding distilled water.

(5) *Charging.* If 220-volt direct current is available, connect the center cells and charge battery as 1 unit. Be

(*Continued on page* 66)

Our Chance to Listen to the British and French Amateurs

Prizes for Sharp Ears

American amateurs are sincerely urged to listen for signals from amateur stations in Continental Europe during the period of December 22, 1923, to January 10, 1924. This will be the fourth series of trans-oceanic tests under the auspices of the American Radio Relay League in an effort to promote better amateur communication between America and Europe.

To facilitate receiving at this end the French and British amateurs will transmit on alternate nights, the transmission hours from 8:00 P. M. until 1:00 A. M., Eastern Standard Time, the French starting the tests on December 22. It is absolutely essential that our fans do not "break in" during the twenty days of testing as we must lend every support to establishing two-way Trans-Atlantic Amateur Communication. Support in this direction is practically assured as the efficiency of our amateur transmitters was adequately proved last winter during the third series of tests.

By way of special inducement to insure "quiet air" during the tests, $3,500.00 worth of prizes will be awarded for the best reception reports turned into American Radio Relay League, Headquarters, 1045 Main Street, Hartford, Conn.

This will be an excellent chance to show that we can copy foreign amateur signals.

CONDUCTED BY JOHN R. MEAGHER

A self-addressed stamped envelope will insure a prompt reply to any queries on radio

New Tubes—What Voltage?—What Resistance?

Mr. George Ross of New York City wants "—— some information on the use of 'dry cell' tubes with a six-volt battery; that is, the proper way of connecting the filament, the correct external resistance value, and in short, anything of interest bearing on the subject."

This is rather a large order, but as doubtless many amateurs wish to know more about filament circuits with certain values of A battery voltage and various kinds of tubes we will cover the subject as fully as possible.

But first we should consider just what a filament circuit is: Figure A represents a simple electric circuit of two series resistances of 50 ohms each connected to a battery of 6 volts. The current in the circuit will equal the voltage divided by the resistance, or .06 amperes.

Suppose we knew the battery voltage, 6, and that the desired current was .06 ampere —find the total value of resistance. Merely divide the voltage by the current: The resistance necessary to restrict the current from a six-volt supply is 6÷.06 or 100 ohms.

In a similar manner, if we know the resistance and desired current rate, we may find the proper voltage by multiplying the two known factors. 100×.06=6 (volts). That is, the resistance multiplied by the current equals the proper value of applied voltage.

The first two conditions are those radio amateurs most frequently encounter: we may summarize them as follows.

1. *The voltage divided by the resistance equals the current rate.*
2. *The voltage divided by the current equals the resistance value.*

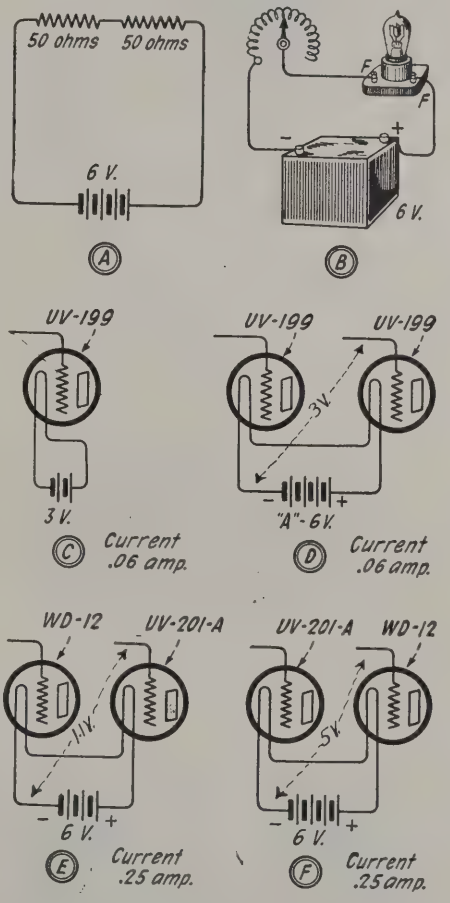
Applying this simple electric circuit to radio problems, we may substitute a mental image of an A battery for the term voltage and a combination of the particular tube and "size" of rheostat for the resistance, see figure B.

Suppose we wanted to find the proper rheostat for a UV-199 tube with an A battery of 6 volts. We know that the current in the circuit should equal .06 ampere. Applying rule 2 we have 6÷.06=100 (ohms). Note however that 100 ohms represent the *total* value of resistance; to find the rheostat resistance we must subtract the filament resistance, which for a UV-199 is 50 ohms. The *rheostat* then should have a maximum resistance of about 50 ohms.

Another case: Find the proper rheostat for a UV-201A tube with a 6-volt battery. Here the current is .25 amperes and the voltage 6. The resistance should equal 6÷.25 or 24 (ohms). As the filament resistance of a UV-201A is 20 ohms, the rheostat must be at least 4 ohms.

Now we will let the reader "dope out" one. If you had a W.D.12 V.T. and wished to use a 6-volt storage battery, what size rheostat would be necessary? (The resistance of a W.D.12 is 4.4 ohms and the desired current is .25 ampere. The correct answer will be found at the end of this department.)

It should be remembered that the filament



of a vacuum tube may be operated advantageously slightly below the specified voltage —so it is well to make the rheostat resistance higher than necessary.

In order to prolong the life of the A battery we must reduce the filament circuit current to as low a value as possible. To do this we should avoid the use of rheostats, using instead either the proper terminal voltage or special circuit connections. Thus with a UV-199 we may use two dry cells in series without a rheostat (Figure C). Or if we have two of these tubes we may put them in series and use a six-volt battery (Figure D). This latter connection would be of benefit in a detector and one-stage amplifier hookup as it would enable us to maintain the grid of the amplifier at a negative potential of 3 with respect to the *negative terminal* of the *amplifier filament.* By judicious use of series filament connections we may dispense not only with extra resistances, but also with special C batteries. Certain combinations of tubes with the same filament current rate are shown at E and F.

In E, if the UV-201A is the A.F. amplifier and the return lead from that grid goes to the negative A battery, we have, in effect a C battery of about 1 volt. By changing the tubes and making the W.D.12 the amplifier we have (in effect) a C or grid battery of about 5 volts.

A near future issue of THE WIRELESS AGE will contain an article dealing with vacuum tubes, their connections and how to get the most from them.

[*Answer: Divide the voltage by the current, 6.0÷.25=24 ohms. And as the tube resistance is 4.4 ohms, the rheostat resistance must equal 24 less 4.4 or 19.6 ohms.*]

Inductance

Mr. R. J. McCutcheon of Pueblo, Colorado, wants "information on inductance coils; which is the best type; why certain wire is specified; what effect the winding form has on the efficiency of the coil. In short, how may I design really good inductances for short wave amateur and broadcasting reception?"

Of the many different kinds of inductances it is difficult to designate one as being "the best," for comparative tests demonstrate that in actual operation there is slight difference in the results secured with any special type, provided the construction is in line with modern practice. Naturally for home construction we believe the single layer coil to be most suitable as manifestly it is one of the easiest to make and if carefully planned will be entirely satisfactory. In addition, calculations of the number of turns for a given value of inductance is simple.

The winding form may have a diameter of about 3 or 4 inches and a wall thickness of not more than ⅛-inch, as it is well to keep the volume of the form as small as possible. Bakelite, formica, hard rubber, wood or sturdy "mailing tubes" may be employed.

The size of wire is usually governed by the amount of space available; No. 24 and 26 are the more common, being a compromise between excessively fine and medium heavy wire, each of which has certain disadvantages. We prefer fine wire and usually wind our own coils with No. 30

(*Continued on page* 68)

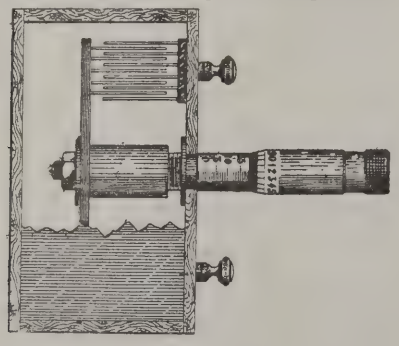
NEW APPLIANCES AND DEVICES

A "Super Condenser" from France

A FRENCH inventor has designed a new variable condenser using a micrometer handle, as shown in the illustration. Movable and fixed plates are made of sections of tubing, mounted concentrically and one set of tubes sliding within the other with a helicoidal movement.

In one of the first models constructed, the capacity varied from zero to .001 mfd. in 20 turns of the handle, or, in other words, a variation of .00005 mfd. per turn. This gives an extraordinary sensitivity to tuning, while use of the micrometer form of handle makes it easy to set the condenser at any desired value. It should not be thought that the twenty turns make it laborious to make large changes in capacity, for the rotating member of the condenser acts somewhat as a flywheel, and a sharp twist is enough to spin the plates all the way in or all the way out in a jiffy, if speed is wanted.

The dimensions of the condenser are such that it can be used easily in present receiving sets. As apparatus of extreme delicacy of adjustment it will be most appreciated by those experimenting with super-regen-



eration, with heterodynes, and with wave meters.

The new device has the additional merit of being practically indestructible under ordinary use, needing no adjustments. And such is its manufacturing simplicity that when it appears on the market it should be available at about the same price as any good condenser of the blade type.

More Space for Brandes

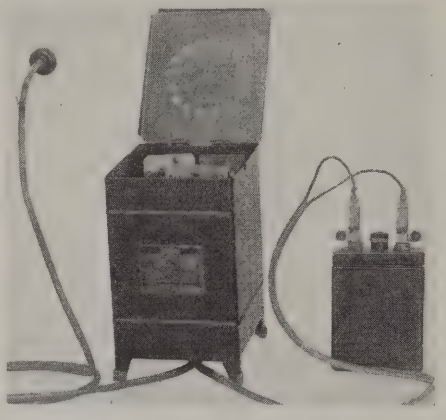
C. BRANDES, INC., New York City, announce the lease of another 5,000 square feet of space in the building at 237 Lafayette Street.

This is the third addition that the company has made in the past year. Early in March, they leased the ninth floor consisting of 5,000 square feet of floor space. In August they purchased a new plant in Newark containing about 48,000 square feet. With the newly leased space, they occupy four floors of the building.

The main office will be continued at 237 Lafayette Street.

Charger for Dry Cell Tube Battery

TO meet the demand of radio operators for a device for charging storage batteries of from two to four volts, to be used in connection with the Tungar Battery Charger, the General Electric Company has



developed and is now placing on the market an efficient adapter.

This is a resistor of sturdy construction, the resistance wire being wound on a porcelain tube. It is designed for mounting on the inside of the top edge of the Tungar casing, which brings it beneath the cover, where it is out of the way and is protected against contact.

It is expected that there will be a great demand for this device because of the increasing popularity of the storage battery for operating the small, or so-called peanut, types of tubes, the storage battery being preferred by a large number to the dry cell for this purpose.

Glass Radio Parts

AS glass is a very good non-conductor, Peterson & Hoffman, Millville, N. J. decided to manufacture radio parts of glass. They claim these parts are moisture proof

and with the lines and figures being moulded in the glass there is no chance for static leakage and no chance for the figure to wear or rub off. They make the parts in sizes to have the bushings fit the various size rods and screws.

Pacent "Everytone" Headset

THE Pacent "Everytone" headset, manufactured by the Pacent Electric Co., New York City has several novel features, not least of which is the special design and arrangement of the magnetic circuit. Instead of two poles each with its separate windings, the "Everytone" has a single soft iron pole piece in the center of the case. As a result, the magnetic pole is concentrated on the center of the diaphragm. It is claimed that additional selectivity is secured through this feature.

The "Everytone" headset is somewhat lighter than usual, weighing less than ten ounces. And, because of the sturdy construction, interior terminal and safety spark gap, this headset is quite "foolproof."

New Type "B" Battery

A "B" battery which has recently been placed on the market by the Burgess Battery Company marks a distinct progress in the utility and convenience of "B" batteries. This is a new type of vertical "B" battery, the dimensions and weight of which coincide exactly with the No. 6 dry cell commonly used for filament current.

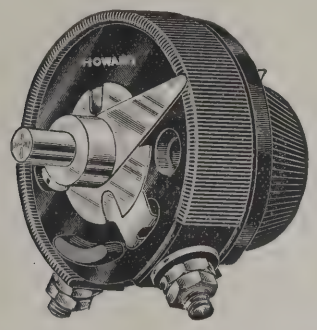
The new battery is a 22½-volt "B" battery known as the No. 5,158. It is six inches in height with a base two and one-half inches square. The terminal connections are brass binding posts at the top. By an ingenious method of construction, the fifteen cells, individually insulated, are placed in a vertical position in two inner compartments. These compartments are arranged one above the other, and the whole is enclosed in a non-metallic, non-inductive, waterproof container.

The electrical capacity of the battery at 2 milli-amperes is about 500 hours, which places it in the group of so-called medium-sized "B" batteries.

The Howard Midget Rheostat

TO meet the long felt want for small rheostats, the Howard Radio Company is now manufacturing a Midget Rheostat, made in three different resistances, 6½, 25 and 40 ohms. The diameter of the base is 1⅝ inches.

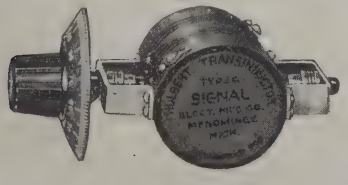
These rheostats are identical in design and construction with their Standard Rheostats, being built of the same high grade materials. This rheostat has been designed more particularly for use in small portable sets where space is limited and where such tubes as the UV-199 and C-299 are used.



The Transinductor

THE limitations of both air and iron core transformers have been overcome to a great extent by a device called the Transinductor, made by the Signal Electric Co. Control of the magnetic inductance, the capacity and the amount of iron in the core is possible with the Transinductor. With it selective tuning is possible, increased amplification is obtained and operation over a broader band of frequencies may be accomplished.

The number of combinations for tuning purposes to be secured through the use of two Transinductors, is very large. Experience will enable the user to tune the set down so that he can receive nearby broadcasting through severe static. Because of the large number of combinations to be secured, he will receive any particular station in a number of different settings; but there is always one combination which is best.



One of the surprising features of the Transinductor is that the entire set of two stages of radio amplification, detector and one-stage audio amplification can be operated on a "B" battery voltage of only 22½. However, for extreme volume it is advisable to use 22½ volts on the detector and 45 to 90 volts on the amplifiers.

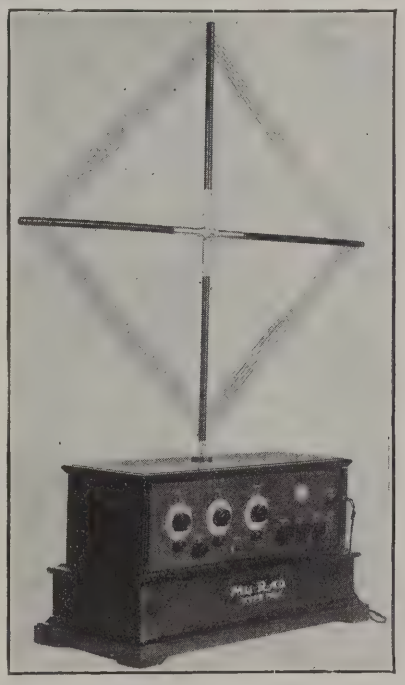
The Transinductor is a new transforming principle and device, used very successfully on radio frequency amplification. A single unit controls the iron flux with respect to position and amount, induction and capacity, bringing out a high degree of refinement of radio frequency amplification. It has 360-degree control; and, in all of these 360 degrees, the important feature of selective tuning of radio frequencies is accomplished through the control of the transforming electromotive-force and the magnetic iron-core flux as well. The induced currents set up in the secondary windings of the Transinductor are always in the same relationship to the impulses of the primary windings, regardless of difference in other functions. Its inter-winding capacity-control brings out the highest efficiency in selective tuning.

The control of the electromotive-force induction in both its primary and secondary windings produces the greatest possible amplification. By being able to control the iron flux the Transinductor is also able to broaden the band of frequencies received.

An Ideal Radio Receiver

THE Mu-Rad Laboratories of Asbury Park, N. J., have designed a new receiver, known as Mu-Rad MA-17, which has sensitivity, selectivity, simplicity and ease of operation to satisfy the most exacting radio enthusiast.

One dial does all the tuning, covering the entire range of wave-lengths. Interference is eliminated and stations selected very easily with two other dials, which are entirely independent of the tuning dial and of each other. The powerful, close stations can be blocked out and far distant stations brought in clearly and distinctly.



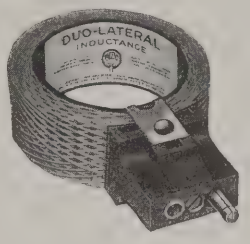
The simplicity of the circuit of the MA-17 makes filament adjustment seldom necessary. Rheostats are however, provided. As a further aid to selectivity and elimination of interference, the MA-17 has a two-foot loop aerial fitted into the top of the cabinet. The loop picks up only stations in its plane.

The Mu-Rad MA-17 circuit is a combination of radio and audio amplification to produce signals loud and clear enough to operate a loud speaker. A voltmeter in the panel provides an instantaneous reading of the "A" and "B" batteries.

The set is enclosed in a solid mahogany cabinet with an Adam Brown hand-rubbed finish. A compartment is provided in the base for "B" batteries, which are removable from the rear.

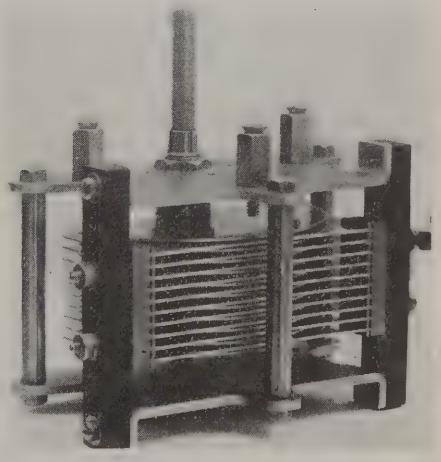
Pacent Duo-Lateral Coils and Mounts

FOR reception of wavelengths between 200 and 20,000 meters, the Pacent duo-lateral coil and mountings may be used to form an extremely flexible and efficient receiver. The duo-lateral winding system is endorsed not only because of its electrical and mechanical qualities, but also because of the resultant sharp and selective tuning.



Recently the Pacent Electric Co. developed a new mounting plug which is much superior to the old type in which a fibre strap around the outer circumference of the coil was used to clamp the coil and plug. In this new design a very small strap passes through the coil and is fastened to the side of the plug in such a manner that tightening a single screw on the front face of the plug makes it grip the coil with a vise-like hold.

Various clever Pacent panel mounting plugs are also on the market; they have the good features of rear panel mounting, positive connections and vernier adjustment. All of these devices are described in a catalogue, "Pacent Radio Essentials", 1923 edition, of the Pacent Electric Co., 22 Park Place, New York, N. Y.



New Cardwell Condenser

THE new type "B" condenser made by the Allen D. Cardwell Mfg. Corp'n of Brooklyn, N. Y., is essentially the same as the old type, but has these special features: ball bearing; white-nickel end plates; special spring contact; drill holes for mounting special coils for Cockaday, Hazeltine and other popular circuits.

The new types are being made in 11, 17, 21, and 41-plate sizes.

Opportunities in Radio Today

(*Continued from page* 53)

words, a man who has sold phonographs or pianos or automobiles will be handicapped when he attempts to sell radio, until such time when he has learned the fundamentals of radio reception, what goes to make an efficient receiver and how it is installed and operated. As a matter of fact, some of the radio schools today are devoting a part of their curriculum to radio merchandising. Equipped with this dual knowledge, radio men are ready to take important positions in this fast growing industry. Your modest radio clerk of today is frequently the head of a respectable selling organization of tomorrow.

Publishing

Here, too, is a branch of the radio industry which accommodates individuals who have a bent towards publishing. First there is the radio writer, the man who understands the various phases of radio and who is able to express his ideas in writing. In short, the man who is gifted with the art of self-expression and who is able to impart the knowledge he has gained to the masses who seek information.

Recent Facts and Figures About Radio

As an indication of the potential field of radio and the many opportunities which are open today, I have a few facts and figures to give here which speak for themselves.

Let us start at the top. Latest census figures tell us there are approximately 120,000,000 in the United States. This means approximately 25,000,000 families or homes. Of this number about 2,500,000 people are already enjoying the benefits of radio. In fact when on Nov. 1 and 2, that famous orator and world figure Lloyd George spoke over WJZ and WEAF, it is estimated that nearly 3,000,000 tuned in to hear his parting messages to America.

Broadcast fans, not only in America, but in Canada, England, France, Cuba, Mexico and elsewhere intercepted part or all of Lloyd George's words. Prior to this perhaps no other man in history ever had so great an audience.

There are at this moment 562 broadcasting stations serving these broadcast listeners throughout the United States. Impressive also is the fact that there are over 1,000 city newspapers and over 5,000 country weeklies publishing daily and weekly radio sections containing program schedules and timely information on how to receive broadcast stations and derive the greatest benefit therefrom. Over 250 text books on radio have been published during the past two years. Something like 3,000 manufacturers are catering to the needs of the broadcasting fan. 1,000 wholesale distributors and over 20,000 retail dealers are selling radio devices today. The number of people engaged either directly or indirectly in radio totals about 250,000. Finally it is estimated that the total volume of radio sales during the year 1923 will reach the huge figure of $150,000,000 and still it is said that this business is yet in its infancy.

Somehow I cannot help but feel that radio offers indeed exceptional opportunities to the man or woman who has the right viewpoint, who is willing to learn, who is honest and who is imbued with a real desire to serve, whether the service be as a radio operator on the high seas or a clerk behind the counter of a radio store.

The Wireless Age Uni-Control Receiver

(*Continued from page* 47)

normal brilliancy it is safe to place the other four UV-199s in their sockets.

Move the potentiometer slider to the negative side of the filament and slowly vary the condenser between minimum and maximum settings. If a whistle is heard, center the dial at that point and slowly move the potentiometer slider toward the positive side of the filament until a point is reached at which the whistling ceases and speech or music is audible; or, if the first tube is tapped lightly a loud ringing sound should be heard, the volume of this sound decreases as different tubes, from the first to last, are jarred.

Of course, the above is what should happen and will happen if the receiver is properly built, but in the event that something goes wrong it is necessary to locate and then remedy the fault. The "symptoms" of poor operation may usually be classified under one of these headings:—

a—No sound whatsoever.
b—Lack of volume.
c—Howling.

In any case, first inspect the wiring, look for wrong connections, missing connections and shorts. Test all the transformer windings again and make certain that the vacuum tube socket contacts are pressing hard against the tube pins. If no sound is heard look particularly at the battery connections; see that the negative B is joined to the positive A and that the A battery polarity is correct.

Lack of volume is usually due to an "open" in the primary of one of the audio frequency transformers.

When there is not much volume and a periodical "click" is heard, there is usually a break in the secondary of one of the audio frequency transformers. The "click" being due to the charge and discharge of the grid through the windings. A break in the secondary does not necessarily cause poor operation however, especially if the break is near the inner turns and the windings have considerable inter-capacity and sufficient leakage to prevent an accumulated charge on the grid.

Howling is usually due to poor transformers; we have never experienced this annoying trouble with the make shown when used in conjunction with UV-199 tubes. But in order to minimize this possibility we have shown a small fixed condenser in shunt to the secondary of the second A.F. transformer. The purpose is to give this winding a differing resonant frequency from the rest so as to prevent self-oscillation at audio frequency. Another method is to reverse the secondary connections of one transformer, thus giving it a different value of shunt capacity; this usually works well on the third stage.

We do not like to slide over this trouble shooting section without giving the reader some information, but on the other hand, if we prolong it and make it at all comprehensive it becomes wearisome and indeed is apt to scare the prospective builder.

One should not imagine he has an immense job on his hands in building this six-tube set for we are confident that if a bit of common sense is used in the construction, everything will sail along smoothly and the results will not only be up to expectations but far beyond even the most imaginative.

Operation

The receiver may be set up anywhere in the home though it is advisable to keep it as far removed from large metallic objects as possible. The loop should be connected to the receiver with a duplex silk covered cord (as short as possible). The batteries may be located at any distance from the receiver, but the connecting cord should be well insulated to prevent accidental short circuitings.

To receive, push the filament battery switch "on" and—

1—Turn the potentiometer slider to the negative side of the filament.

2—Vary the condenser between minimum and maximum, centering it at any point where a whistle is heard, then—

3—Move the potentiometer slider slowly toward the positive side of the filament until a point is reached at which the whistling ceases and speech and music is audible.

When the call letters of that station are determined, mark them on the dial in small letters directly in line with the indicator, making a small mark to locate the exact point of reception. Do the same with all other call letters heard.

?

Dear Reader:

There are times in life when we draw our own pictures—pictures that no artist can paint.

Rieger Research Corpn.

"The Fulfillment of an Ideal"

Say Dale, that tip on Curkoid Tuned Radio Frequency you gave me last month was a regular Christmas present.

Kept it dark, but I grafted the two steps into my old Curkoid hook-up. Yea-bo—I've sure been pulling 'em in. And they all sound like local stations.

Now this is my party. Saved it for Christmas Eve because it's my first one in my own home and I wanted just you folks here to help celebrate.

It's funny how things you learn when a kid keep cropping up as you slide along through life.

Tonight, before you came, I was fiddling with the knobs and all at once I heard some Christmas carols.

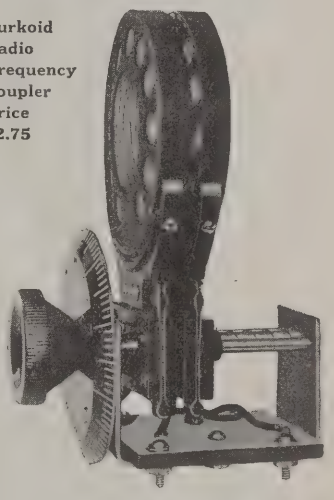
Sounded like they used to when I was a kid and the singing cast a spell. You know, it took me right to the singers, their old-fashioned clothing, the dark walls, the brightly-burning logs in the fire-place, the mistletoe and holly, the pitcher of cider, the fiddles, the happy, cheerful, joyous faces, that real genuine holyday cheer of the years gone by. I saw the old-fashioned Christmas. Curkoids carried me through the ages, I saw the "Wise men of the East being guided by the Star." I was wrapped in the serenely glorious starlight of the great night. I realized to the fullest the glories of the days that have passed.

And I thought how wonderful it all was that we were going to sit here tonight and listen in with millions of other folks to singers and organs and orchestras in all parts of the country spreading the Christmas message broadcast, and reminding us that life is not all dig and scramble and all that sort o' thing.

There, I've got that out of my system. Grin if you want to, but if you're honest you'll 'fess up that once a year, on Christmas Eve, you're doing the unusual and thinking of everybody else instead of yourself.

You are right, Gene. And it's a safe bet that the men who make Curkoids are home right now, hoping that they are helping make Christmas happy and real to the folks who are using them.

And say, won't there be some tickled fellows in the morning when they get a Curkoid outfit that will bring in the New Year's chimes from New York and Los Angeles?



Curkoid Radio Frequency Coupler Price $2.75

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Triple coupler		7.50
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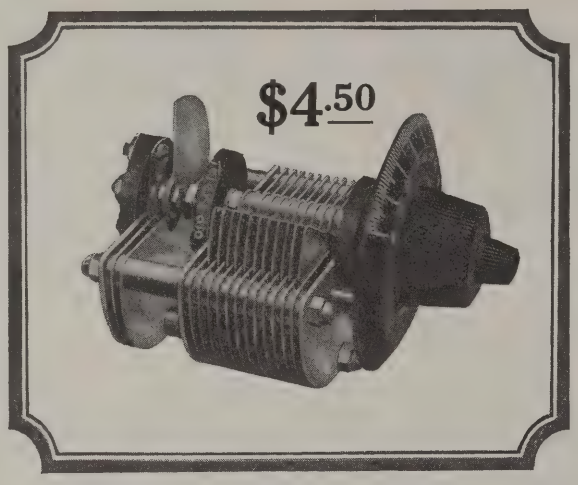

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The principal factors that brand reliability in condensers are sturdiness and accuracy.

Teleradio Vernier Condensers are well worthy of these qualities. The plates are extra heavy polished hard aluminum that will not warp. Rigid construction throughout insures perfect plate alignment. Special locking feature prevents short circuiting of vernier, and provides permanent and perfect contact. Capacity is accurate and constant. All metal parts nickel plated. Built for bench or panel mounting. Guaranteed electrically and mechanically perfect.

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Room 315, 326 Broadway, New York City, N. Y.

Footing the Broadcasting Bill

(*Continued from page* 52)

should not be paid for. It would seem to the author that broadcasters, sooner or later, must organize their broadcasting activities on the same basis as a magazine. The reader of any magazine pays only a part of the cost of producing the copy which he receives. Indeed, if circulation expenses are taken into consideration, the reader pays nothing to the publisher in most instances. The burden of footing the cost of publishing falls on the advertiser, who must carry his message to the reader through the columns of the magazine.

In broadcasting, we may yet have the same arrangement. The listener will receive sixty per cent. of purely entertainment features, free from publicity of any kind. And then, ingeniously interlaced among the entertainment features, there will be forty per cent. of publicity features, which will not vary greatly from the present talks, except that they will be more interesting because of the greater thought and care brought to bear in their preparation. He will be a great impresario who will blend the various entertainment features and the wonderfully interesting talks into a program of such strong appeal that the receiving set dials will remain fixed.

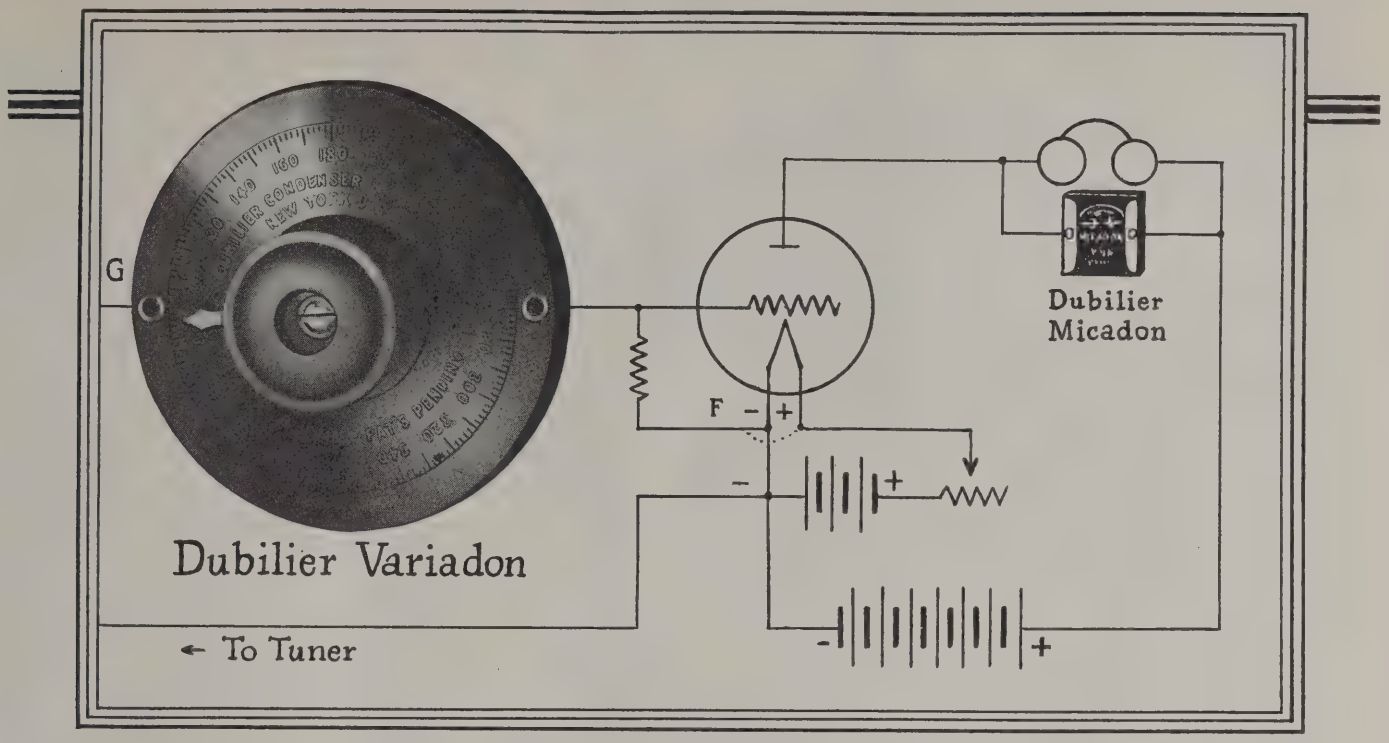
Meanwhile, and until the broadcasters solve their own troubles, we may continue to enjoy the gratis-free-for-nothing programs to the utmost. All that we are asked to do is to write an occasional line to the various broadcasters and their artists, assuring them of our deepest appreciation for their efforts to please us.

A Real 100-Volt "B" Battery

(*Continued from page* 60)

sure the positive terminal of the battery is connected to the positive wire of the current supply. To control the charging rate a 40 or 50-watt lamp is connected in the circuit as shown in figure 4a. If 110-volt direct current is available the battery must be charged in two units as shown in figure 4b. If the battery is to be charged from 110-volt alternating current chemical rectifiers are used to convert same to direct current. The battery must be charged in 2 units as shown in figure 4c. A good rectifier can be constructed for a few cents by following the directions below:

One piece of aluminum 1½ x 3 inches, 1 piece of lead 1½ x 3 inches, and a glass cup are required. The aluminum may be cut from an old pail or cooking utensil.



At F the filament terminal of the grid leak is shown connected to the negative side of the tube. Occasionally better results are obtained by connecting grid leak terminal to positive side of the tube.

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Better than a Variable Grid Leak

BETTER than the average variable grid leak and a fixed condenser in a grid circuit are the Variadon, the Dubilier variable mica condenser, and a fixed resistance.

Better because it is difficult to control the resistance with the average variable grid-leak but certain and easy to control the capacity of the grid-circuit with the Dubilier Variadon.

Thus used with a fixed resistance the Dubilier Variadon greatly increases both the selectivity of the set and the volume of the signals. Thus disappear the difficulties experienced when poor variable grid-leaks are used.

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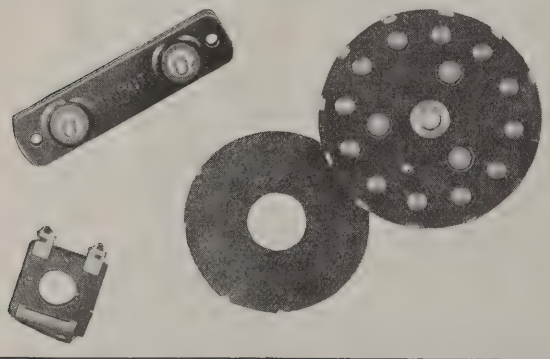

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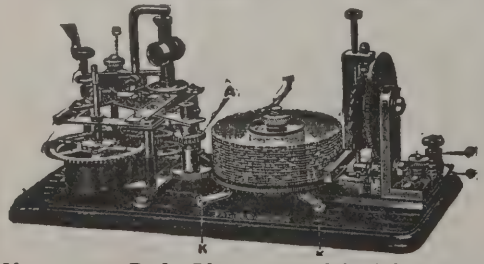

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If you own a Radio Phone set and don't know the Code—you are missing most of the fun

As this aluminum is not very pure the plates will have to be renewed often. A borax solution (saturated) is used. Holes are drilled in one end of the plates to hold the binding posts. The plates are then bent to fit the edge of the glass and prevent same from touching the bottom. The lead plate is connected to the current supply and the aluminum plate is connected to the positive terminal of the battery. This rectifier will charge batteries of from 1 to 25 cells at .5 amperes (with a 50-watt lamp in series).

The battery should be charged at a rate of .4 or .5 ampere for the first time, and not over .75 ampere thereafter. It will take about five days for the first charge. If possible a hydrometer should be used to determine the condition of the battery while charging. The solution should test 1.300 when the battery is fully charged. If a small enough hydrometer is not available, a voltmeter or gassing sign can be used. By voltmeter test, the cells will register 2.4 when fully charged. By the gassing sign the solution will be cloudy and bubbling lively when the battery is fully charged.

(6) *Care of Battery.* The battery should be kept in a cabinet to prevent dust or dirt falling into the tubes. Keep the battery in a cool place in Summer and warm place in Winter. After first month's use examine the battery for loose connections. Only pure distilled water should be added to keep solution at proper level.

LIST OF MATERIAL

½	Gallon Sulphuric Acid Sol. (1300)	$ .40
4	Pounds Sheet Lead @ .10	.40
13	Positive Plates @ .22	2.86
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50	Test Tubes 1 x 7 inches @ .05	2.50
11	Separators @ .03	.33
		$9.35

The writer will be pleased to answer any questions pertaining to the construction of the battery.

Information Desk

(*Continued from page* 61)

double cotton covered, for in our estimation the increased direct current resistance is more than counterbalanced by the decreased distributed capacity; and the D.C. resistance is of less importance in a regenerative or radio frequency amplifying receiver than is the value of distributed capacity.

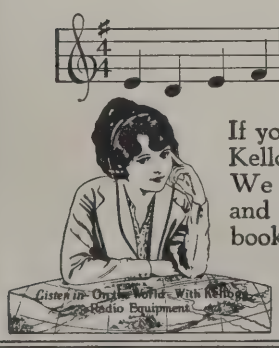
For amateur use we firmly believe that solid copper is preferable to stranded conductors (litzendraht). Unless the "litz" is of *perfect* quality and each strand shows a complete circuit and unless, in making terminals, each strand is soldered, this type of wire will not give as much satisfaction as solid copper. There is also the question of "workability" and cost; litzendraht is difficult to use and is quite costly; solid

Your Kellogg Radio Christmas

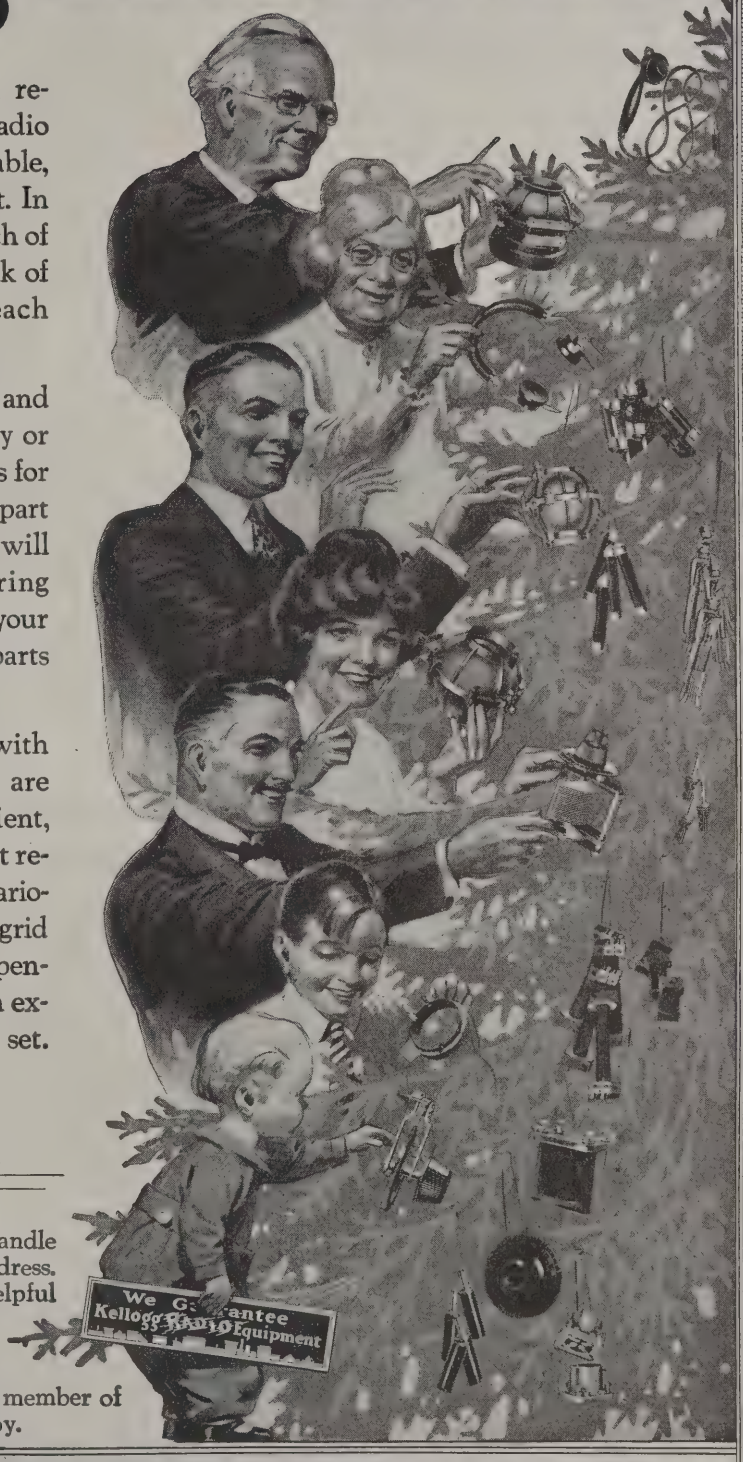
Here is a way to get a wonderful receiver of Kellogg parts that most radio fans will tell you, are the most reliable, durable and efficient on the market. In several million families this year, each of us will be racking our brains to think of some Xmas present to please each member of the family.

Forget all this trouble and work, and plan a radio Christmas. Ask the boy or dad to make up a list of reliable parts for a simple set; then each one buy one part for someone in the family, and you will have a receiving set that will bring Christmas carols and the world to your fireside, if you have efficient Kellogg parts carefully put together.

Such assembling is an easy matter with Kellogg radio equipment. There are thousands of circuits, some very efficient, both as to distance and selectivity, that require only a condenser, coupler [or variometer], tube socket, fixed condenser, grid leak, tube, dials, and a few other inexpensive parts. You don't need to buy an expensive cabinet to have a good radio set.



If your dealer does not handle Kellogg, send us his address. We will send you our helpful and valuable radio hand book. Start today on your Christmas receiving set, and make every member of the household happy.



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6 Volt,	60 Amp.	$ 8.50
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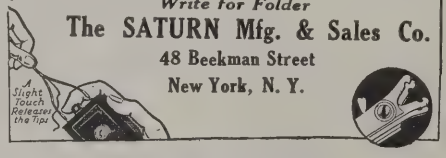

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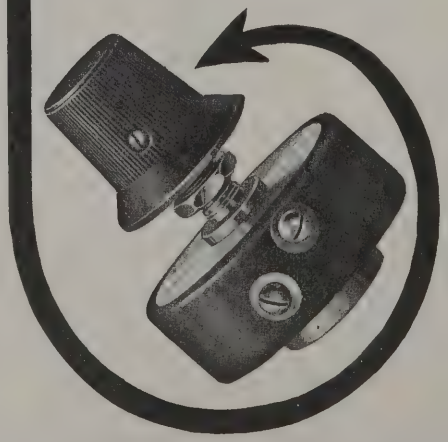

copper is very easy to use and is not at all expensive.

The covering or insulation is of importance for two reasons. First, it acts as a spacer between the copper conductors and in this way determines, to a large extent, the value of distributed capacity. For this reason alone it is well to use at least a *double* covering of cotton. Secondly, the insulation keeps adjacent turns from short circuiting; *i. e.*, touching each other. On this last account it is advisable to employ white insulation as the dye in colored coverings affords leakage, detrimental to sharp tuning.

From the above statement it is evident that an efficient inductance comprises a form of small volume wound with fairly fine double white cotton covered solid copper wire.

In finishing the coil, one should dry it thoroughly in an open oven (to drive out any moisture in the cotton insulation) and apply to the winding a very thin coat of collodion (which may be purchased in any drug store). In mounting the coil keep it removed from large metallic and insulating bodies—use a simple bracket. Further, in connecting the inductance, endeavor to eliminate the necessity for taps—that is, design it so that with a small loss-free variable condenser in shunt, the wavelength range will just cover the desired band.

Possibly our saying "design it" may be cause for a "way down east" feeling. We assure you that it isn't as hard as it may seem. Almost every radio textbook contains "dope" on how to find the value of inductance, and though we have striven to answer your inquiry as completely as possible there is a great deal more to this interesting subject and, without trying to act as a press agent for anyone, we suggest that you get hold of E. E. Bucher's "Wireless Experimenter's Manual" if you want some good non-technical information on the proper design and construction of inductances. We personally have a well thumbed copy on our desk.

Selectivity

Mr. R. Irvin of Salmon, Idaho, writes: "I have a radio and audio frequency amplifying loop receiver which has given excellent results not only in the quality of reproduction, but also in the high degree of sensitivity and selectivity which it affords. However, in an effort to increase my range I have been using an outdoor antenna. It is entirely satisfactory, but there is still room for improvement in the selectiveness. Do you know of any system which will give me more selective results than an ordinary inductively coupled tuner?"

Yes, it is quite possible to improve an *ordinary* inductively coupled tuner to meet the requirements of a radio frequency amplifying receiver, and the necessary changes may be made easily. The difficulty with the usual type of coupler in such circuits is due to the high residual capacitance and inductance coupling even at the minimum point.

In addition, because of the proximity and size of windings, every variation of coupling effects a noticeable change in the self-inductance of both the primary and secondary circuits, consequently retuning is necessary.

A method of reducing the effect of both objections is shown in the diagram, figure 1. Here, the secondary coupling coil is comprised of only five turns and change of

THORDARSON

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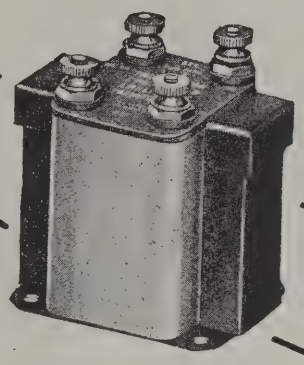
The Colin B. Kennedy Co., internationally renowned for their QUALITY RECEIVING SETS, are equipping all their sets with Thordarson super-transformers.

BE  CONVINCED

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coupling has but slight effect on the self-induction of either circuit. More important, very loose coupling is provided when the secondary is at right angles to the primary. It is evident that any standard coupler may be used if the rotor is rewound with only five turns. The only other change is the addition of a secondary loading coil which, for short wave reception, may be comprised of 40 turns of No. 30 D.C.C. wire on a thin 3-inch form; this load should be placed away from and at right angles to the primary inductance.

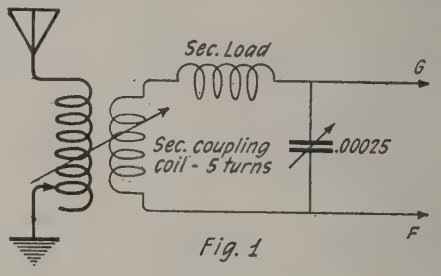

Fig. 1

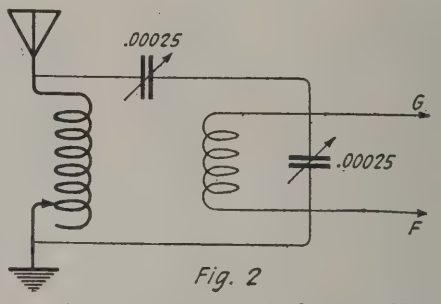

Fig. 2

Another system is shown in figure 2. Here a variable condenser is connected between the antenna and grid and, as the primary and secondary inductances are separated and fixed at right angles to each other, the only noticeable coupling is that provided by the variable condenser. Very loose coupling may be obtained if the minimum capacitance value is low. The advantage this system offers is that of ease in construction as no movable parts—other than the small coupling condenser—are required.

For all around purposes the first circuit is probably the better, although there is very little difference in actual results.

Regenerating Above 400 Meters

Mr. Edwin Garbutt of Stapleton, New York, has trouble making his variometer-tuned-plate regenerative receiver oscillate above 400 meters. He asks: "Is there any way of making the set oscillate throughout the entire range up to 600 meters?"

It appears that the maximum inductance value of the plate variometer is not sufficiently high to enable tuning of the plate circuit over the range covered by the grid circuit. There are numerous ways of overcoming this difficulty but probably the most effective and simple scheme is that shown in the diagram.

Here a small coupling inductance connected in the grid-filament circuit is placed in inductive relation to the plate variometer. This coil may be wound with 10 turns of number 30 D.C.C. wire on a form of approximately the same diameter as the stationary winding on the variometer.

In connecting this coil there is only one proper way. The correct connections may be found by experiment while the receiver is in actual operation.

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Re-PRODUCTION

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To the Great Radio Public
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FOR Christmas give the radio enthusiast his fondest expectation—a perfect radio re-PRODUCER, the *Atlas Loud Speaker.* Natural re-PRODUCTION, identical with the original in the broadcasting studio, is completely achieved. The patented "double diaphragm" responds uniformly to the full range of sound intensities. Adjustable to each individual set and receiving conditions. The *Atlas Loud Speaker* is a gift not only to an individual but to an entire home, an unmistakable sign of your regard and thoughtfulness.

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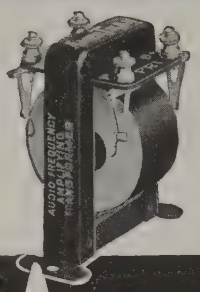

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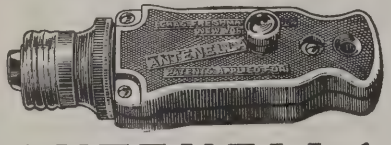

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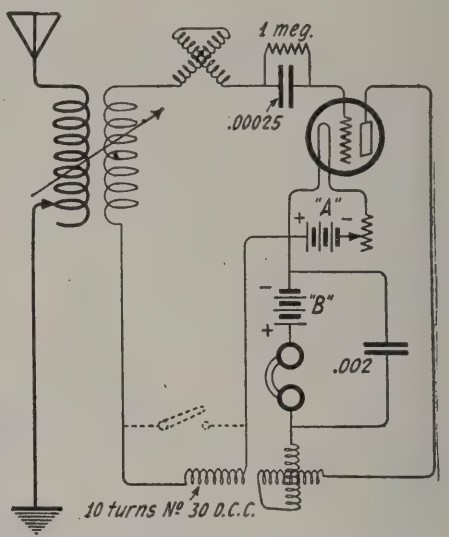
If the oscillations persist at the lower end of the band despite adjustment of the plate variometer a short circuiting switch may be provided to short out the extra coil.

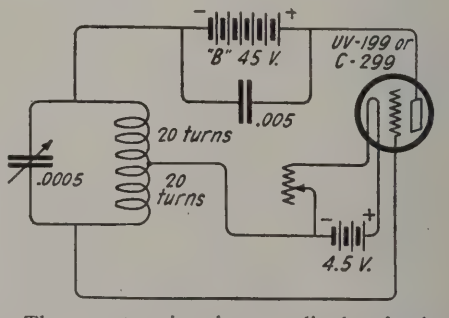
Also, look over the wiring and make certain that the return lead from the grid goes to the positive terminal of the A battery and that the grid leak also goes to this side. Frequently, with a hard tube, increase of the plate voltage increases the range of self oscillation for any given setting of the plate variometer.



Separate Heterodyne

Mr. J. H. Cordy of Toronto, Canada, writes: "Will you please publish a hookup of a good separate heterodyne for use with a radio-frequency amplifying receiver in the reception of C.W. signals; may the same device be used equally well with a super-heterodyne?"

We are showing on this page a complete wiring circuit of a short wave oscillator of very simple construction. It may be used with the super-heterodyne system or in conjunction with a non-oscillating receiver for C.W. reception. In addition, it is a valuable instrument for the experimenter as numerous tests and measurements may be made with it. If desired, the one tuning control, the variable condenser, may be calibrated in wavelengths.



The construction is exceedingly simple. Only one .0005 mfd. variable condenser, a suitable inductance, tube socket and resistance are required. The condenser should be of a very good make and of the "straight line" type if the oscillator is going to be calibrated. The inductance is wound on a thin 3-inch form with 40 turns of No. 30 D.C.C. wire with a tap at the exact center.

We would suggest the use of a UV-199 or C-299 as the oscillator may then be made up complete in a shielded cabinet with the

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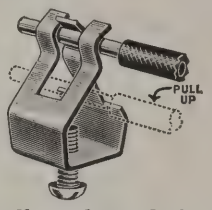

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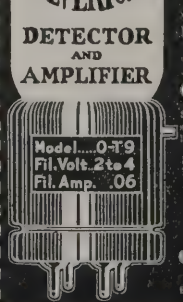

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A and B batteries inside. Another advantage of using this type of tube is that of low filament current consumption; permitting operation over a period of months with very little attention.

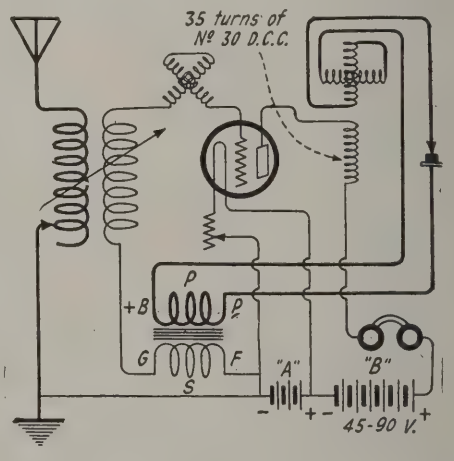
It is urged that the oscillator be made independent of other equipment and instruments as it may, at some time or other, be used for different purposes than those originally thought of. Indeed a short wave oscillator of this type finds its most useful sphere in radio measurements and once the amateur has learned how to use it the value of making it a separate unit will be fully appreciated.

Changing a Three-Circuit Regenerative Receiver into a Reflex

Mr. W. E. Jones of Denver, Colo., writes: "I have a standard variometer-variocoupler receiver using a UV-201A tube as detector. Is there any way in which I could use this material in a reflex circuit?"

If you care to go to the extent of making part of the circuit over, all your present equipment may be used in an extremely good reflex hookup.

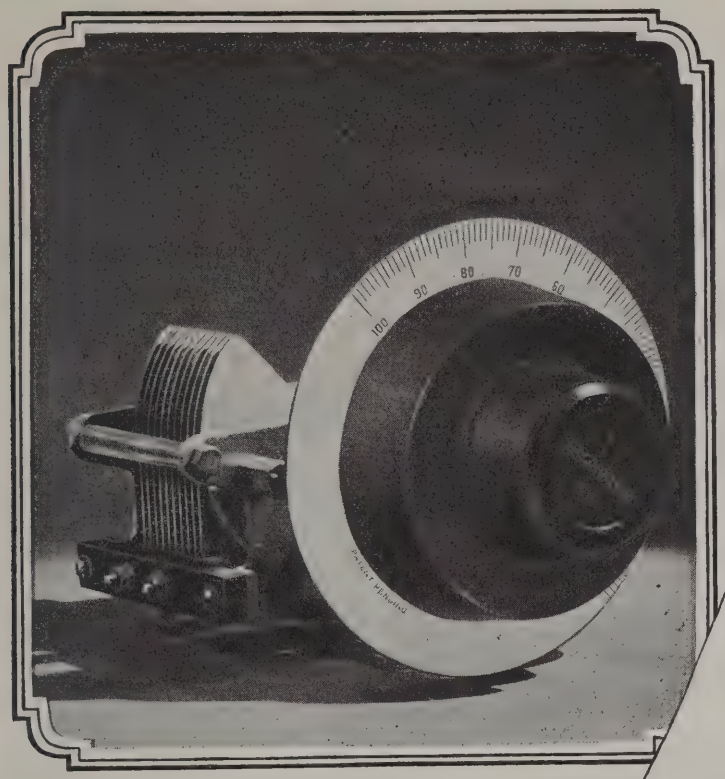
You will need one audio frequency transformer, preferably of a low ratio, and a good crystal detector in addition to the other apparatus. Also, it will be necessary to make a "major operation" on the plate variometer. This change is noted in the diagram.



A small coil of 35 turns of No. 30 D.C.C. wire is placed in close inductive relation to the outer winding on the plate variometer; and this coil is substituted in the plate circuit for the variometer. Both terminals of the variometer are connected to the crystal detector and primary of the audio frequency transformer.

In rewiring, leave the antenna circuit as it is now in your receiver. But short out the grid condenser or remove it entirely and run the lower lead of the secondary of the audio-frequency transformer to the *negative* side of the A battery. Be sure that the rheostat is in the negative A battery lead and that the secondary is grounded as shown. Disconnect the leads to the plate variometer and connect them to the extra coil. Then connect the terminal of the variometer to the crystal detector and primary of the audio frequency transformer. Use from 45 to 90 volts of B battery.

Tuning is in many ways similar to the regular variometer method. But in this case the second variometer is tuned to resonance with the other circuits *not* to effect self-



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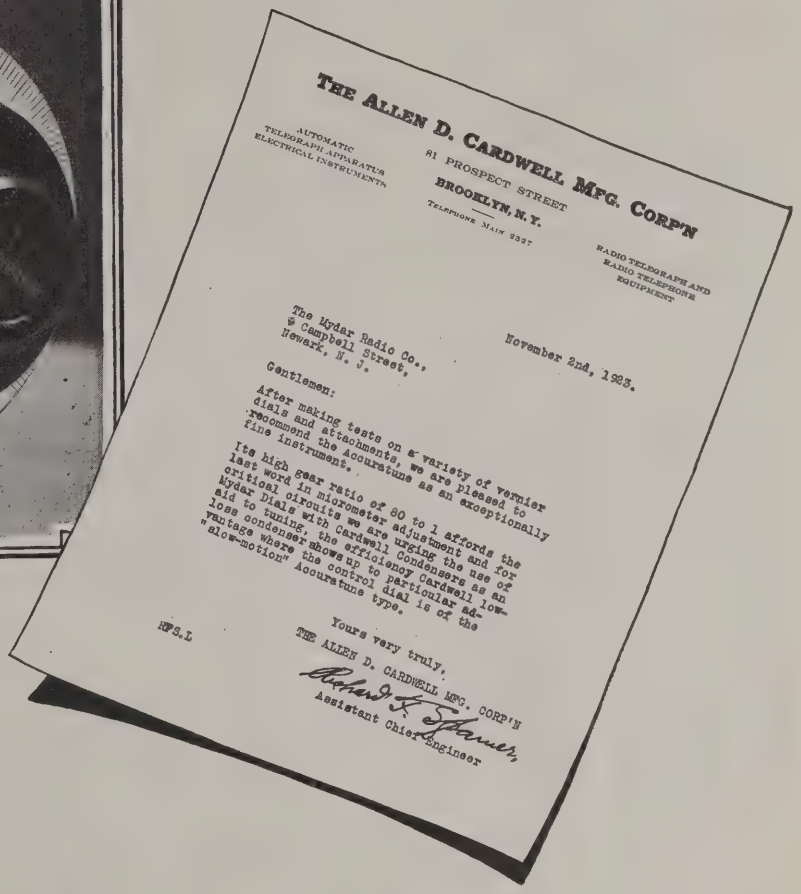

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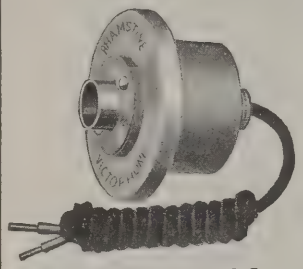

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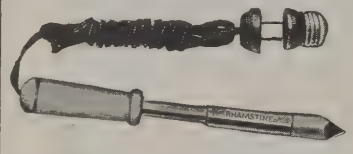

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oscillation but to help in preventing it. Use a sturdy mineral and, if possible make the adjustment semi-permanent.

It is of advantage to have the connections to the extra plate coil correct; try reversing them for best results. To use ground reception alone, connect the ground to the aerial post and adjust the switch lever of the primary inductance for each wavelength to be received.

Because of the inherent selectivity of this circuit, the antenna coupling may usually be fixed at a position near maximum coupling; however, for extreme selectivity the variable coupling control has many advantages.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of the Wireless Age, published monthly at New York, N. Y., for October 1, 1923.

State of New York, } ss.
County of New York }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared J. Andrew White, who, having been duly sworn according to law, deposes and says that he is the Editor of the Wireless Age, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Wireless Press, Inc., 326 Broadway, New York, N. Y.

Editor, J. Andrew White, 326 Broadway, New York, N. Y.

Managing Editor, None.

Business Manager, J. O. Smith, 326 Broadway, New York, N. Y.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent. or more of the total amount of stock should be given.)

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Radio Corporation of America (owning all the stock of Wireless Press, Inc.), 233 Broadway, New York, N. Y.

The names and addresses of stockholders of Radio Corporation of America owning or holding 1 per cent. or more of the total amount of its stock are as follows: Cameron Blaikie & Co., 44 Broad Street, New York; Jas. B. Colgate & Co., 36 Wall Street, New York; General Electric Co., 120 Broadway, New York; The International Radio Telegraph Co., 165 Broadway, New York, and United Fruit Co., 131 State Street, Boston, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

J. ANDREW WHITE, Editor.

Sworn to and subscribed before me this 2nd day of October, 1923.

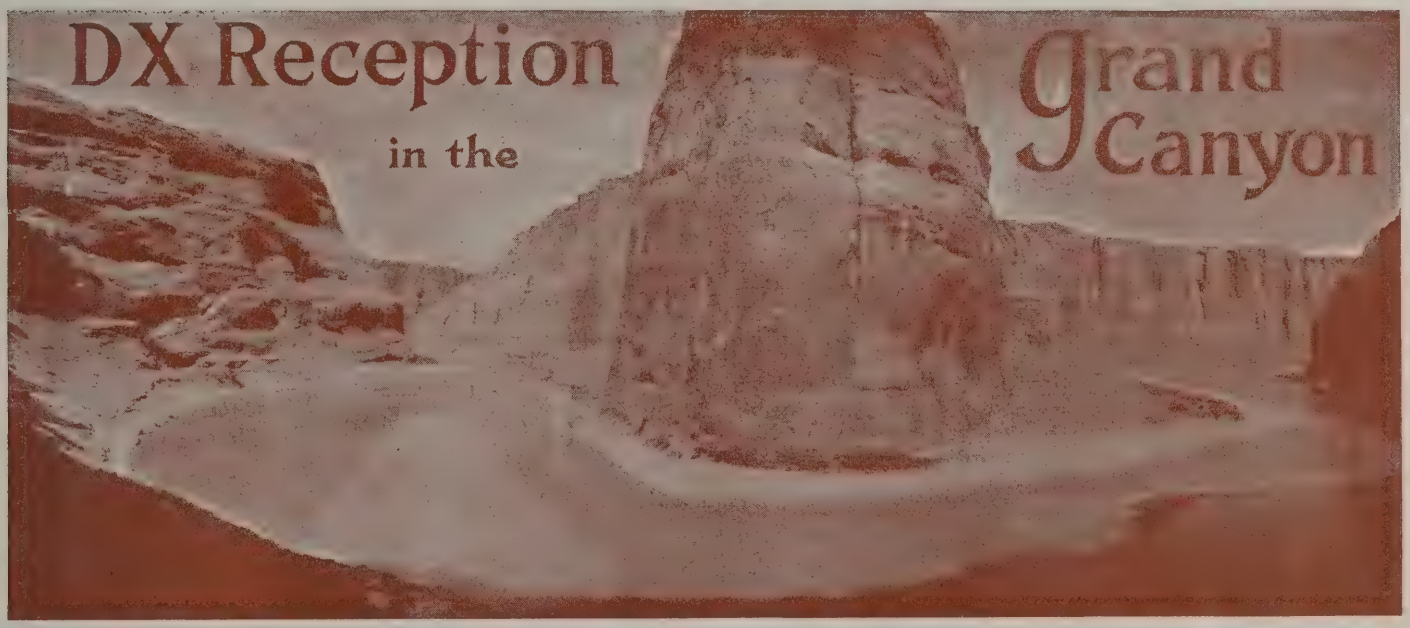
[Seal] M. H. PAYNE, Notary Public.

(My commission expires March 30th, 1924.)

THE WIRELESS AGE

"America's Foremost Radiophone Review"

VOLUME XI JANUARY, 1924 NUMBER 4



Colonel Birdseye's Exploring Party Keeps Radio Contact With the World While Thousands of Feet Down in the Canyon

By Max Abel

RADIO fans who sometimes complain of the difficulty of rigging an aerial on the top of a dwelling or even in the woods about camp by using tree tops as masts for the pleasure of picking up broadcasting, should listen to the story of DX reception in the Grand Canyon of the Colorado as told by Col. C. H. Birdseye, of the United States Geological Survey, who has just returned to Washington, D. C., after a trip of 300 miles through the roughest waters in that mighty chasm. The dominant purpose of the trip was to make an accurate survey of the canyon and to locate sites at which dams could be built to utilize the wasting waters for flood prevention, power development, and irrigation.

Colonel Birdseye tells a graphic story of the trip down the canyon, which was made in four wooden boats, supplemented by a canvas canoe. These boats carried all the supplies and instruments of the party and also, except at portages, the men themselves. In addition to the usual instruments used by engineers and geologists the party had a radio-receiving outfit—Aeriola, Sr.—which was modified for the trip by R. L. Atkinson, the expert mechanician of the Geological Survey.

On July 18 the party left Flagstaff, Arizona, the railroad station nearest to the point of departure, for Lees Ferry, 140 miles away. Here they remained, under stress and distress of a temperature that reached 110 degrees in the shade nearly every day, putting the boats and equipment in order.

On August 1 the party left Lees Ferry and camped that night at the head of Badger Creek Rapids, 7½ miles below Lees Ferry. Here the radio set was tried out, and in spite of adverse prophecies, some of them widely circulated in print, that a radio set could get nothing in the depths of the canyon, KHJ, at Los Angeles, was heard plainly, although the canyon here is narrow and nearly a thousand feet deep. From this point down the

Colonel C. H. Birdseye, Chief of the U. S. Geological Survey Grand Canyon Exploration party

The Grand Canyon Survey Party. Colonel Birdseye in center of picture

canyon the radio outfit was set up from place to place and received messages from Los Angeles, Salt Lake City, San Francisco, and on one occasion from Colorado Springs.

The radio outfit which enabled the party to keep in touch with civilization consisted of an Aeriola Sr., with two steps of amplification, using U.V. 201-A tubes throughout, which had been modified in the instrument shop of the Geological Survey to meet conditions which were to be expected in the canyon. This set, together with A and B batteries, was placed in a waterproof box, so that in the event of the overturning of the craft in which it was carried, there would be no danger to the instrument. The antenna wire, 150 feet in length, was carried on a small reel to facilitate winding on moving camp. Prior to breaking camp arrangements had been made with the Los Angeles Times (KHJ) and Desert News (Salt Lake City) (KZN) to broadcast items of interest to the party.

At Soap Creek Rapids, about 11 miles below Lees Ferry, camp was made where the party learned by radio of the death of President Harding, three-quarters of an hour after it occurred—probably before the majority of people of the United States had learned of it. Here the rim of the canyon is 3,000 feet above the floor.

On August 8, the boats passed Vasey's Paradise, 31 miles below Lees Ferry, so named by Maj. J. W. Powell, the first explorer of the Canyon, in honor of George Vasey, a botanist, who would have found the numerous ferns, mosses, and other plants here a very interesting study. The party filled their canteens, explored a large cave, made surveys of a possible dam site, and camped on the limestone ledges at the head of another rapids, where radio messages were received from KHJ at Los Angeles, though not without great static interference.

August 12, the party reached Nankoweap Creek and found a small stream of clear water—a decided luxury to men who had been drinking the water of the ever muddy river for nearly two weeks. In camp that night at the mouth of Kwagunt Creek the men thus camped in the depths of the canyon heard and enjoyed the items of the daily news and the baseball scores, as well as the fine concerts broadcast from Los Angeles. At this point the top of the canyon is 5,000 feet high.

FOR three months the intrepid Geological Survey Party, conducting their own 300-mile survey through the tortuous depths of the Grand Canyon, were able to keep continuously in touch with the civilized world through their radio apparatus. Three thousand feet below the canyon rim and hundreds of miles from the news centers, they learned of the death of President Harding three-quarters of an hour after the occurrence, probably before the majority of the people in the big cities knew of it. A mile deep in the great chasm they heard the news of the terrible earthquake in Japan. And finally, after months of trying adventures, they had the unique experience of hearing a broadcast announcement of the safety of their party.

Visitors Cause Cook to Walk Out

On the evening of August 29, the party camped at the mouth of Hermit Creek where a good flow of drinking water was found, and was joined by Colonel Crosby, Superintendent of Grand Canyon National Park, and a large party that had been made up to see the boats run Hermit Creek Rapids, the roughest kind of a stretch of water. The influx of so many visitors threw the cook "up in the air" and he threatened to leave the party at Bass Trail, the next stop. The party had been receiving radio messages about the impending coal strike, a threatened industrial and domestic calamity, and some of its members had vivid recollections of domestic trouble about cooks, but here was a "labor situation" right in the canyon that looked bad, and culinary service at once assumed a high value. However, as he was evidently to be lost to the party, a new cook was sent for.

For a number of days the radio outfit was out of commission due to a broken "pig-tail" connection on one of the rotors, but on the evening of September 8 at the mouth of Tapeats Creek, the radio outfit was again in use and KHJ came in clear. The party then heard that a serious earthquake had occurred in Japan and that the Washington baseball club had won a game. Here, too, the walls are nearly a mile high.

Newspapers Tell of Disaster to the Party

On October 2, after running many small rapids and escaping a 20-foot rise in the river, the party reached Diamond Creek, 164 miles below the

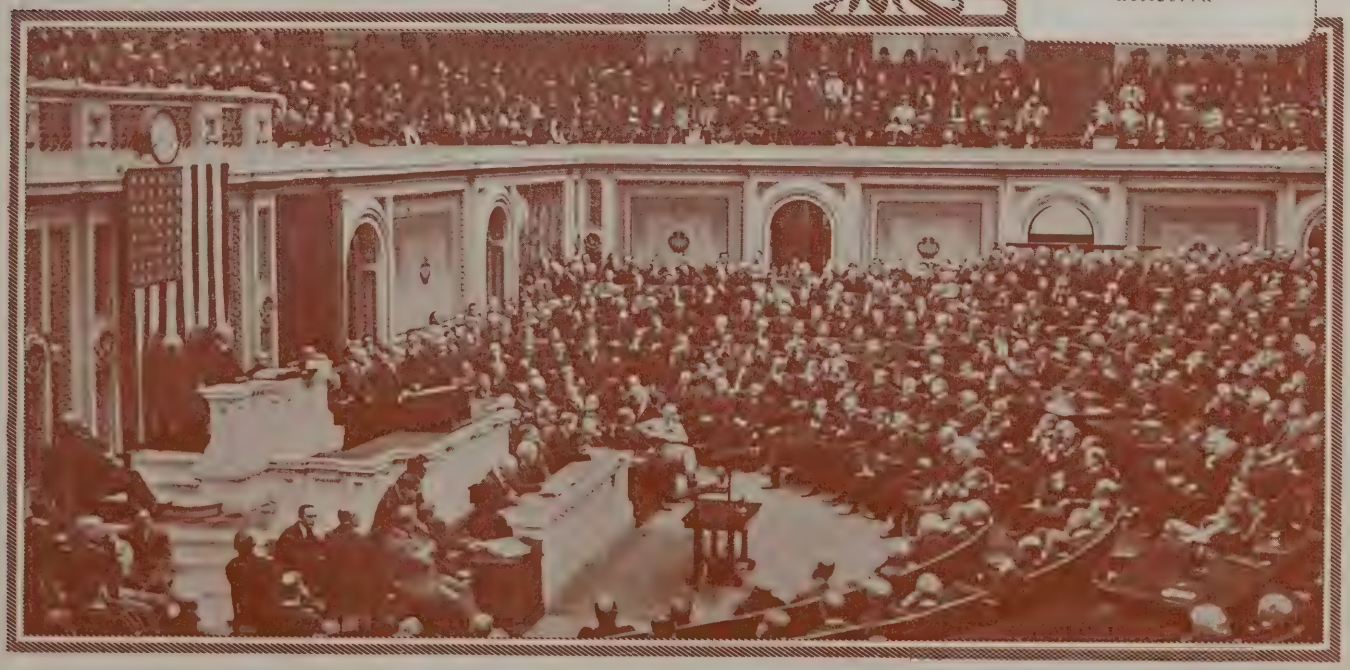
(*Continued on page 78*)

Trying out radio receiving set in the Grand Canyon

President's Message Broadcast

President Coolidge's first message to Congress, a pronouncement of tremendous political importance, was delivered direct to the country by radio

George A. Wick, of station WCAP, operating the radio amplifying control from the gallery while the message was delivered



While official Washington, including the representatives of foreign powers, crowded the galleries of the great chamber in which the Senate and House of Representatives were assembled at noon on December 6 to receive the President's message, radio fans all over the eastern half of the country listened to the address through their receivers

YASHA Bunchuk, solo 'cellist of the Capitol Theatre Orchestra which broadcasts such popular concerts. "Roxie" says this 'cello is worth $18,000, so no wonder this artist's music is so delightful.

Some Interesting Broadcasters

Chief Crawler is ill at ease before the microphone. Read on page 27 how WJZ radioed his war-whoops

Here's the little chap with the big voice whose heart-throb songs delight listeners-in to Capitol Theatre concerts — Wee Willie Robyn

Florence Macbeth, leading coloratura soprano of the Chicago civic opera company, who has become a favorite with radio fans

World's Leaders Use Radio

Oscar S. Straus broadcasts his message on "A Constructive Program for Peace" from station WDAR, Philadelphia

The political arena is all set for 1924. Here we have Senator Hiram Johnson driving home his argument before the microphone

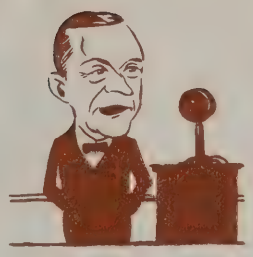
Mrs. Mary Roberts Rinehart, whose mystery stories, to say nothing of her lovable characters Tish and "K," are the delight of novel-readers over the English-speaking world, is shown here broadcasting her Glacier Park adventures from WJZ

Dr. Paul Kammerer, one of the foremost biologists, comes to America to explain his proof of Darwin's Theory of Heredity. Dr. Kammerer spends a few moments each day in radio diversion

Broadcasting Congress

Shall the Nation Sit in the Congressional Galleries?

By Otto Wilson



Not alone the President's message, but specially important debates might be broadcast

WITH Congress again holding forth in Washington the idea recurs, "Why not install a broadcasting device in the Senate and the House and let the people of the country listen in on the proceedings of their political servants?" The present session promises to be filled with fight and excitement. The Congressmen from the Northwest are up in arms, and since they have the balance of power in both houses they are not going to be steam-rollered into silence. Then the issues that will be fought back and forth will play a large part in determining the success or failure of many presidential booms, including that of President Coolidge himself. What could be more interesting to the politically minded than to be able to pick up a receiver and hear Senator La Follette or Senator Magnus Johnson doing battle with Senator Watson or Senator Cummins on the question of guaranteeing the farmer a price for his wheat or of taking over the railroads of the country?

It could easily be done, but it probably will not be and for one very good reason—the country would be bored stiff in an hour. Usually we think of Congress as debating seriously the big questions that shape the country's destiny. Of course it does devote hours and days to the League of Nations, the revision of income taxes, and such broad subjects, and occasionally the visitor to the galleries is lucky enough to sit in on a tense and historic debate. But by far the greater part of

the time of Congress is spent in grinding laboriously along on plain government grist. Sometimes the proceedings are funny, once in a while highly dramatic, but most of the time they are just plain tedious. If, for instance, the eager political student in a back county in Indiana or Missouri could have picked up his radio receiver one day toward the close of the last session and listened to the oratory of the House, he might have been prepared to hear a profound discussion of our foreign relations or a ringing appeal for help to the farmer. But this is what would actually have assailed his ears:

"I notice every afternoon and every evening when we have a night session that shortly after adjournment the corridors are filled with smoke. I am

told that the smoke is emitted by the burning of refuse paper in some of the fireplaces here. I do not think that is a very sanitary plan. I do not think the corridors of the House should be filled with smoke, because rarely is the air from the outside allowed to come in here. I think that practice should be discontinued."

"I think that situation has been cared for. I am so informed."

"Oh, no. Only the night before last, when we ran until 11 o'clock, when I came over here from the House Office Building at half past 11 there was smoke in the corridors."

"I am sure the gentleman is mistaken about that. I think that must have been because of the members smoking as they were going out."

"Oh, no. I know the difference between cigarette smoke and smoke from burning paper. It is an abuse that should be corrected."

"The situation the gentleman mentions is an abuse and should be corrected, and I think it will be."

"How many chief janitors have we?"

"Just one as I understand it."

"They have one in the Senate drawing $2,000 a year; and we have one for the House drawing $1,800 a year. Is there one for the Supreme Court?"

"I was referring only to the House organization."

"This is just one Capitol building. Is there one for the Supreme Court?"

"Not a chief janitor."

"But there is a separate janitor for the Supreme Court."

"There must be."

"Then in one building we have three separate janitor forces. Why could they not all be put under one head, so that we would have only one chief janitor?"

"I think the gentleman might make that recommendation."

"It will cut out at least two positions as chief janitor."

"Does the gentleman think that the Senate would agree to do that? They want to control their own janitor force."

"If we called attention to it the people at home might persuade them to agree to it."

"Mr. Speaker, I ask for recognition in opposition to the resolution."

"The gentleman from Massachusetts."

And so on. We can imagine how absorbed the radio listeners would be in the question of smoke in the corridors of the Capitol and how quickly they would be aroused, as the worthy member of the House suggested, to rise up and demand that the Senate should stop immediately having a janitor all its own.

Of course there are occasions when the American people generally would give a good deal to hear what was going on upon the floor of the two houses of Congress. Thousands would have tuned in on that session in April, 1917, when war with Germany was declared, and there are many lesser occasions when the debate is tense, dramatic, and of the highest moment to the country. Probably after a while some arrangement will be made by which these special occasions will be provided for and the people will be enabled to hear history directly as it is being made. But for the present there apparently is no special demand for such arrangement and there is no plan to provide it.

One exception should be made to that statement. When Mr. Coolidge addressed Congress radio fans in the East were able to catch his words as he uttered them.

(*Continued on page 29*)

A 100,000 attendance marks the Chicago Radio Show as a big stride forward in the development of real popular interest.

The Chicago Radio Show

A week of high pressure Radio

As related by one of its conspicuous participants,

R. H. G. Mathews

AS we look back on the five days of November 20th to the 25th spent in the Chicago Radio Show, we have a vivid pulsing picture of surging crowds, flashing color, polished exhibits, attractive displays and energetic salesmen. From this jumble of impressions many high lights stand out.

In the first place, some idea will be gained of the size of the show from the total attendance, which was in the neighborhood of 100,000. And this crowd was more than a mere crowd of onlookers. It will be recalled that at previous shows the great general public paraded around, walked through such booths as were handy, with vacant looks on their faces, stuffed their pockets full of literature and wandered on out, without asking questions or displaying any particular interest. This year's show was different! The crowd came, poked its pencils inside of things, tore them apart and nearly mobbed the salesmen in attempting to secure information. This fact is best illustrated through the story of one of the larger exhibitors at the show, who started out with four salesmen in his booth the first night. The second night this same exhibitor had fifteen salesmen working in his booth and could have used more. This year's crowd did more than "look"; it wanted information. It was going to buy sets and wanted to know why it should buy any particular set, and it was there to find out.

BIRD'S EYE VIEW OF SOUTH HALF OF THE CHICAGO RADIO SHOW
The arrangement and preparation of the booths was attractive and well adapted to the purposes of the show. All the exhibitors felt well rewarded

KNOWLEDGE AMAZES

As soon as the doors opened at 2 p. m. the radio curious began to pour in, and at 7:30 p. m. the lines seeking to gain entrance were backed up for a great distance north and south along Wabash Ave., approaching the entrance.

The widest range of radio equipment was represented. The simplest bit of apparatus was on display, and at the other extreme were beautifully consoled and cabinetted sets running in price to $1,000 and more.

The crowd was made up of all sorts and ages of boys and girls, men and women. Exhibitors who were demonstrating expressed surprise at the knowledge of radio which the general public possesses. Young men and old men who admitted that they knew nothing of radio a year and a half ago were able to discuss sets and devices with fluent intelligence.

—From the *Chicago American*.

Last year's attendance at the Chicago Radio Show was approximately 60 per cent. youngsters. An analysis of this year's attendance shows that less than one per cent. of the attendance was composed of children. Mr. Charles Hall, President of the Coliseum Company, in whose building the show was held, states that a greater number of automobiles were parked on the streets surrounding the Coliseum than have ever been so parked at any show ever held at the Coliseum, and in this connection it will be remembered that the Coliseum is the home of the annual Chicago Automobile Show, as well as many other great expositions.

From these facts it is very evident that radio *has come to stay;* that its appeal is now to the business man and his wife, that it has passed the "fad" stage, and has become a great settled industry, one of the greatest in the world.

Letters received by three Chicago broadcasting stations

The exhibitor who pays good money to exhibit in a show is always inclined to be critical, and his judgment of the value of a show is therefore of considerable importance. The writer has yet to find one exhibitor at the Chicago Radio Show who is not clamoring vociferously of the tremendous value of this last Chicago Radio Show. Jobbers and dealers were there in profusion, and they were there to do business. They went through the show with a fine tooth comb, made their selections and placed their orders then and there.

SHIFTING OF LOUD SPEAKERS KEEPS CROWD CIRCULATING

Too much credit cannot be given U. J. Herrmann and James S. Kerr, who managed the show. It was the smoothest running exposition of its size that the writer has ever seen, and in this opinion the exhibitors are again unanimous. Demonstrations were not allowed. The show management installed and operated a concealed receiver, the output of which was supplied to banks of horns in various parts of the big hall, which is nearly 500 feet long and 200 feet wide. The music of the various Chicago broadcasting stations was brought in clearly and beautifully throughout the show. The squeals and howls of interacting receiving sets were absolutely absent. For the first time the public at a radio show really had an opportunity to hear for itself what radio music was like. Because of the fact that the receiver in operation was concealed, no manufacturer received any more credit for the demonstration than any other, and the crowd was kept in circulation by the switching of the reception from one bank of horns to another.

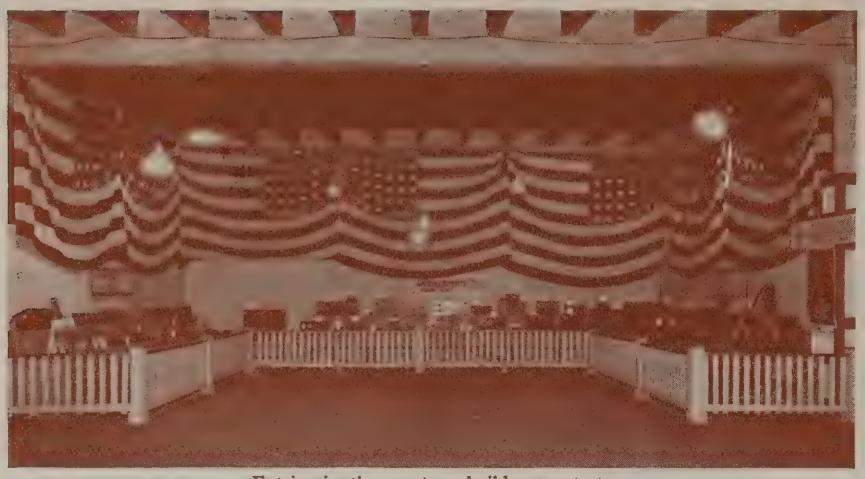
Some Crowd!

Not omitting The WIRELESS AGE booth, where our old friends met and new friends were made

OVER QUARTER MILLION REPLIES TO BROADCAST STATIONS

Great interest centered in the "Listeners Vote Contest" which was conducted during the week preceding the show by the three large Chicago Broadcasting Stations, KYW, WDAP and WJAZ. The listeners of these three stations were asked each night to send in communications stating just what class of entertainment they desired most to hear broadcast. As an incentive to secure sufficient answers, so that this would not be a minority vote, over $5,000 worth of prizes were donated by the various exhibitors at the show. These prizes included 27 complete receiving sets of various types as well as accessories of all kinds. The replies as they were received by the three stations were numbered, and each night at 10 o'clock at the show drawings took place, 100 prizes being drawn nightly, the prize winners being announced by the three stations.

The total figure on the number of replies received by these three stations is stupefying. While we all realize the tremendous power of radio and radio broadcasting, until it is brought home forcibly to us in some such way as this, we really have no conception of its immensity. A total of 263,410 replies were received,



Entries in the amateur builders contest

of which 170,699 were received by WJAZ, 37,800 by KYW and 55,711 by WDAP. Assuming not over one person in fifty will take the trouble to send in a telegram or letter in a contest of this kind, apparently the three stations mentioned had a total audience during the week of 12,253,250. Ponder this figure for a moment and try to realize how many people it really represents, and then try and realize the power that such an audience will have along the lines of political and other efforts, if its power is ever consolidated and brought to bear on any one issue.

Another drawing card at the show was the hourly performance of Francill, the radio wizard, who demonstrated the most complete radio-controlled model ship that can be imagined. His thorough control of the ship was demonstrated by the fact that he could at will sound its horn, move it in various directions, right, left, front or back, light various lights all over the ship, ring its bell, release toy balloons imprisoned within it, fire its cannon, play a phonograph concealed within, imitating a ship's band, or do all of these things or any of them simultaneously.

In the theater at the south end of the exhibit hall were displayed continually various "Radio Movies," illustrating the principles of radio communication in sugar-coated form with a little comedy mixed in to make them palatable. Here also various well known radio engineers gave talks each night. Among the speakers were E. T. Flewelling of well known Flewelling "Flivver" circuit, Dr. Lee DeForest, Channing Pollock, well known author and playwright, William Schnell, Chief Engineer of the Electrical Research Laboratory of Chicago and others.

Near the theater were exhibited the various entries in the three amateur building contests. The first of these contests was unlimited, as to conditions, the prizes being $75.00, $50.00 and $25.00, respectively. The second contest was restricted to school children only, the prizes being five in number, $30.00, $25.00, $20.00, $10.00, and $5.00. The third contest was for sets of trick or novel construction, the three prizes being $20.00, $10.00 and $5.00. The judges, E. T. Flewelling, William H. Schnell of the Electrical Research Laboratory and R. H. G. Mathews of the Chicago Radio Laboratory, spent a great deal of time in carefully comparing the various exhibits. The first contest was won by a 12-tube Superheterodyne exhibited by Harry P. Kanuf, 718 Grace Street, Chicago, Ill. The second prize was awarded to Joseph Dorothy, 517 West 148th Street, New York, N. Y., who exhibited a three-stage radio frequency detector and two-stage audio frequency receiver.

The second contest was won by Ulysses Coates, 11733 Vincennes Ave., Chicago, Ill., and the third contest by John Neis, 1533 Wolfram Street, Chicago, Ill. No attention was paid to the type of circuit used in awarding these prizes.

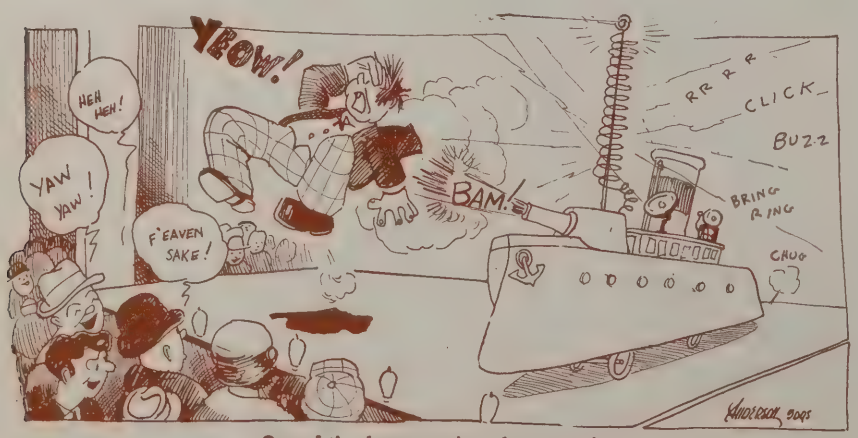
The displays offered by the various manufacturers and dealers showed great originality, and many interesting and novel features. Our old friend Grebe drew tremendous crowds with a projecting machine which ran a film of his factory showing the processes of construction. The *Chicago Evening American* booth was built up in the form of a broadcasting studio, and in fact considerable broadcasting was done from the booth through the Westinghouse Station KYW, with which the American has a broadcasting agreement. Other Chicago newspapers were also represented by booths and exhibits.

Francill and his ship

In the Commonwealth Edison booth was found a beautifully built white and gold Sleeper Monotrol Set, and near it was found the Tuska-Miner Superdyne Set which is attracting so much attention.

The honors for beautiful and expensive construction unquestionably go to Federal, who sent to the show under heavy guard a Sterling silver receiving set, the cabinet being beautifully hand chased and engraved, with solid silver knobs and controls throughout. This set occupied a glass case in the center of the exhibit hall and attracted much attention.

(*Continued on page* 82)



One of the demonstrations demonstrating

WHOOPS *of* Wild Rodeo Warriors Radioed From WJZ

As told by STUART HYDE HAWKINS

FOR the first time in a century or more the peaceful urbanity of thousands of homes throughout the eastern part of the country was rudely shattered by the gutteral gibberish and woeful wails of frenzied American Indians, for station WJZ broadcast the radio debut of the tribe of Flathead Indians who had arrived in New York for the Madison Square Rodeo, on Tuesday afternoon, November 13.

Under the guidance of Grey Scott, who escorted the tribe all the way East, the warriors arrived at the broadcasting station, and for once the soulful solemnity of the richly furnished studio seemed totally unsuited as the background of a radio concert—if concert it may be called—for the feather-filled head-dress and wampum-wound moccasins of the Chief of the Flathead Tribe and his chosen braves needed a far less civilized setting than is customary in Manhattan studios.

From the moment of arrival Scott's entire energies were directed towards keeping the descendants of the original Americans from either bolting outright or destroying whatever apparatus they could see, for the radio was to them a terrifying manifestation of the awful power of the Great Spirit. After considerable coaxing and coaching, Chief Michele Crawler, summoning by a visible effort his total reserve of chiefly courage, approached the microphone and hurled a short series of unintelligible grunts and growls into the ether, and Sam Vincent, who has mastered the lesser intricacies of American as it is spoken, was forcibly held by the redoubtable Scott while he murmured a weak—"Chief he say he glad be New York; like big totem-pole" (which Scott later assured us meant "skyscraper"); very pleased be here; don't like little box-on-stick-that-make-shout-you-hear-he-don't." By which we surmised that the Chief was not as enthusiastic about broadcasting as we might have hoped. "Chief he say—he say—" —here Scott gave him a forceful swift and silent reminder that he was addressing a half-million people and should realize the dignity of his position and cease stammering —"Chief he say damn lot more, he like New York, G'bye."

Chief Crawler (right) heaves a sigh of relief at having safely talked into the little box-on-stick, while Sam Vincent shows his bravery by touching the stand; Sam Nose looks longingly at the corner from which he has been dragged

From the farthest corner of the studio emerged the corpulent form of Sam Nose, who had taken no chances while his comrades were addressing the "box-on-the-stick," and had retired to the most distant spot possible; and by the combined efforts of Eddie Paul, the Publicity Manager of the Rodeo—who was very evidently being cursed in every variation of the Flathead language for having conceived the broadcasting plan—and Grey Scott, he was shepherded to the side of his two brothers-in-misery at the microphone. From the announcer's station came the words "the Flatheads will now sing one of their war-songs—," and Sam Nose commenced a furtive pounding upon an immense tom-tom. After what seemed like hours, the Chief broke the vocal silence with a long-drawn, quavering wail which had more of the funereal than of the martial nature; a moment later Sam Vincent joined in—sounding for all the world like an uncertain "wandering saxophone" in a jazz orchestra—and gradually the volume swelled, the spirit changed, until under the stimulus of the tribal war-song their fear of the "box-on-the-stick" became a deep and abiding hatred for

(*Continued on page* 82)

Radio de Luxe

Messmore Kendall, Owner of the Capitol Theater, Prizes His Radio Sets and Places Them in Beautiful Surroundings

Interview by William A. Hurd

MR. MESSMORE KENDALL

A TWENTY-thousand-dollar radio set! And in a moment I was actually going to behold such a treasure!

After I waited, however, for well over two hours in the second room of the richly appointed suite which serves as an office for Messmore Kendall, proprietor of the Capitol Theater, while his secretary guarded the private sactum in a capable, pleasant manner, she arose quickly, motioning tor me to follow. Walking through the third, and larger room, down a hallway and through another, still larger room, I was abruptly ushered into Mr. Kendall's private office.

A hasty glance revealed a spacious, well lighted room, luxuriously furnished, but in good taste.

Seated comfortably in an overstuffed chair I studied Mr. Kendall's features while he finished signing some papers. A strong, kindly face suggesting a keen sense of humor hardly betrayed the man of finance and power I had expected to meet. This was a man of vast capacity for the finer grasp of art and tradition.

I rather sensed that direct reference to the dollar value of his possessions would hardly gain his confidence.

"You have a very fine radio and I would like to know more about it," was my opening suggestion.

"Yes," he replied, becoming interested, "I have a set in my home at the top of this building, one at my Dobbs Ferry residence and another on my farm."

Here was a real fan! I asked him to tell me about them.

To begin with, his apartment, which comprises the entire upper floor of the Capitol Theater building, and is only accessible by means of complete identification, is distinguished by the most sumptuous furnishings. Rare period pieces, antiques and Oriental rugs decorate its high-ceiled rooms and establish an example of what can be done in the successful combination of luxury and comfort.

The radio cabinet, massive as it is, does not seem out of proportion with the other large pieces, all hand carved and individual. In fact, a grand piano, seeming at rest in one corner, is nearly obscure.

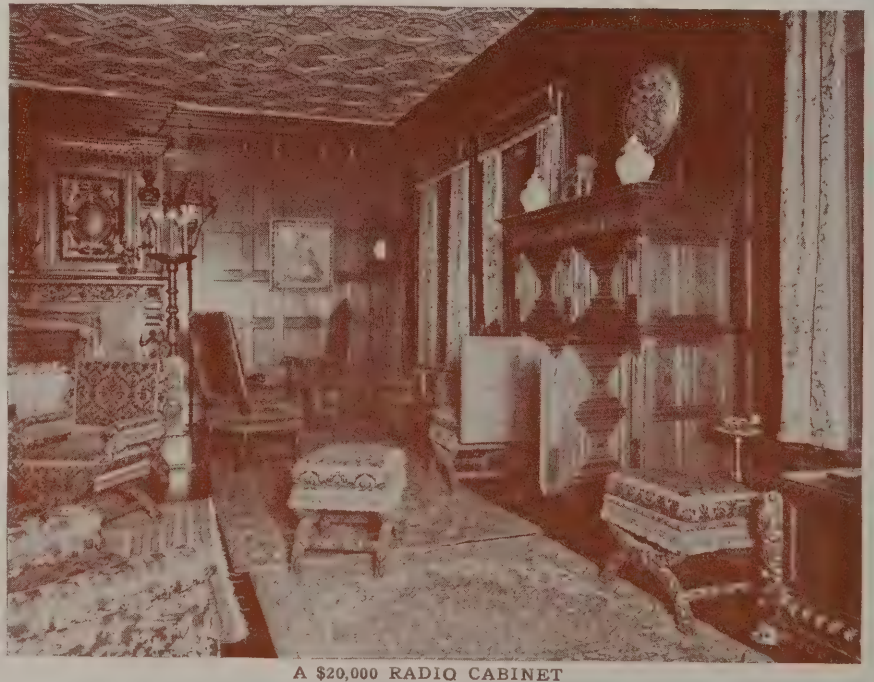
Mr. Kendall had hesitated for a moment, seeming to weigh the importance of details, but decided, he warmed completely to the subject.

"Upstairs," he began, "I have the set mounted in a fine old cabinet. In the evening I can tune-in on WEAF and hear the Capitol Orchestra playing. At the same time I can hear the music in a dictaphone which is connected to the orchestra pit by direct wire. Then, if I wish, I can open a window situated just above the theater through which the music comes direct from the instruments."

Messmore Kendall is a New York lawyer who conceived a beautiful idea. Recognizing the important place which the moving picture had come to take in all of our lives, he yearned to give the movies a setting worthy of the splendid productions which mark a continual progress in this art—a setting that would enhance their value. From this conception came the Capitol Theater, a grand home of the film-play, where thousands of people every day enjoy the unspoken drama in perfect comfort, surrounded by decorations of extraordinary beauty, and thrilled by a great orchestra of unusual quality.

As our interviewer has intimated, Mr. Kendall has some interesting hobbies which mark him as a man of broad and useful activities. His homes contain his considerable collections of rare paintings and antiques, which latter include a number of valuable Duncan Phyfe pieces. He is an ardent bibliophile and one of the illustrations with this article shows part of his library of 6,000 volumes, most of them first editions.

THE WIRELESS AGE identifies Mr. Kendall with the undeveloped future of radio as an agency of culture and entertainment. It is to men such as he in his Capitol Theater project has shown himself to be that we must look for many of the great ideas yet to be born that shall popularize radio and multiply its benefits. Radio needs the interest, enthusiasm and vision of big men and women.



A $20,000 RADIO CABINET

A corner of the living room in Mr. Kendall's home located at the top of the Capitol Theater building. The massive cabinet in the foreground to the right contains the wireless set on which he listens-in to the orchestral music that is transmitted by direct wire to WEAF, New York, and from there, broadcast to millions. The cabinet is a rare, hand-carved antique. In the background, between the fireplace and the clock, the paneling is actually a door opening on a private stairway leading to the theater

IN THE PRIVACY OF MR. KENDALL'S LIBRARY IN THE DOBBS FERRY HOME
The radio set, shown at the lower right hand corner, is kept in a closet located at one end of the room from where it may be enjoyed by opening the door. The circular walnut table, today occupying its original position, was used by Washington during his stay there

The Capitol, one of the largest theaters in the world, has a seating capacity of 5,000. The magnificent decorations mark it as a veritable palace for photo-plays. No introduction is needed here to the Capitol Orchestra, nor Rothafel, the radio impresario of the Capitol Theater, as both are well known to countless thousands throughout the country.

"The sensation of hearing the same music simultaneously," Mr. Kendall continued, "through three different mediums is certainly worth while."

And small wonder that he should be so enthusiastic over this, the child of his imagination.

I asked Mr. Kendall about the farm.

"On the farm," he answered, "I have a Radiola cabinet set that is easy for the folks to operate, but I have so little time to get away from New York I have to confine myself for the most part to listening-in upstairs or at Dobbs Ferry.

"At my home in Dobbs Ferry," he continued, "I keep the set, which is a Grebe, in a closet located at one end of my library. There I can enjoy radio in the home to the utmost."

Mr. Kendall was reluctant in answering questions concerning the history of this old Tory house in which George Washington planned the Yorktown campaign that brought to an end the American Revolution.

It was to this house, also, in 1783 that Washington again came to arrange for the evacuation of New York, and from which Washington and Governor Clinton, with their escort of troops under General Knox, took up the march down the old Post Road to re-enter the City of New York.

Originally a farmhouse of the picturesque Dutch Colonial type, its character has been faithfully preserved in the restoration. It illustrates two distinct phases of Colonial architecture and contains a rare collection of early American furniture and antiques.

Mr. Kendall, though a true fan, is less concerned with the technique of radio than the entertainment it offers

THE STAIRWAY IN THE DOBBS FERRY HOME
The original hand rail and spindles have been used in the restoration of this stairway. It leads to the upper hall, which has become a part of Mr. Kendall's library, where his radio set and the choicest of his six thousand volumes, most of them first editions, are kept. The Dutch chime hall clock, on the left, is dated 1686

when consummated by the influence of home surroundings. He has certainly placed the two together in perfect harmony. And probably because he recognizes in radio a permanent contribution to culture rather than a laboratory novelty.

Broadcasting Congress

(*Continued from page 23*)

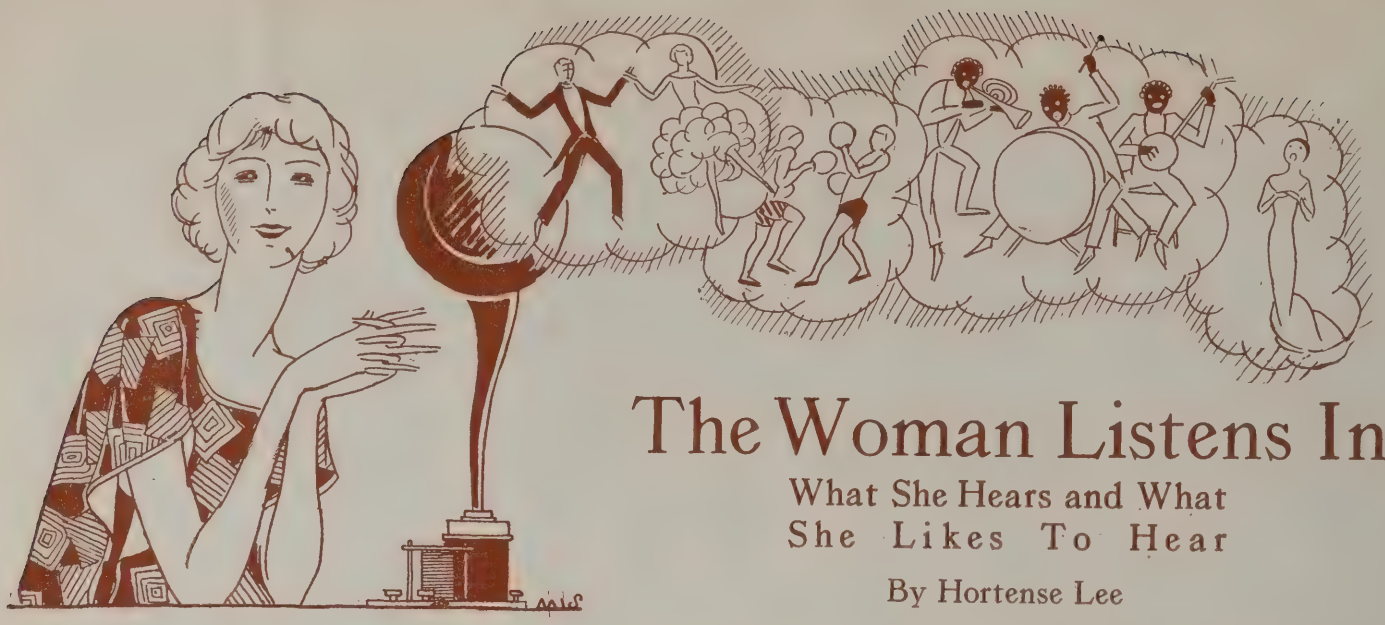
A device has been installed in the House of Representatives chamber for broadcasting the President's message. Anyone who has ever attended a session of the House knows that the chamber is so large and the confusion so great that it is hard for those in the galleries to keep track of what is going on, and the Speaker is constantly rapping for order so that the members themselves can hear. To help out this situation the Western Electric Co. a year or two ago volunteered to install an amplifying device similar to that used at big public gatherings. A cluster of horns was suspended from the ceiling, and they were connected with microphones on the Speaker's desk, the desk of the reading clerk, and the stands from which members make their longer speeches. These microphones can easily be connected with telephone wires running to sending stations in Washington or New York, from which the words of Congress can be sent flying out over all the Eastern states. It is of course mechanically possible also to link up sending stations all over the country by using the wires of the Bell Telephone Co., but that would require special arrangements between that company and the broadcasting stations as the company itself has stations as yet only in Washington and New York.

On December 6 the radio fans of the Eastern states were able to listen to the important pronouncements of President Coolidge, which may make history. But if they want to hear what Congress thinks of these and other weighty matters, as well as some which are not so weighty, they will have to come on to Washington and take a place in the galleries as heretofore.

Honoring a Forerunner of Radio

BRIDGING almost a century, the tinkle of a tiny bell, the first in the world that ever rang in response to an electro-magnet, was heard from coast to coast and across the Atlantic Ocean when programs in memory of Prof. Joseph Henry were broadcast December 17 from WGY, the General Electric radio station at Schenectady, N. Y., and WHAZ, the Rensselaer Polytechnic radio station at Troy, N. Y.

In 1831 Professor Henry discovered an electro-magnet by which he was able to transmit signals to a distance.



The Woman Listens In

What She Hears and What She Likes To Hear

By Hortense Lee

PERHAPS you think an Egyptian woman is a veiled, suppressed, secluded creature, still a century or two behind your modern suffragette. But if you listened in to WJZ, one evening in December, you heard of the famous "Ladies Wafd" of Egypt; of charming Egyptian ladies using the methods of western politics and suffragism; of street parades; of street harangues from a motor car; of boycotts. These are things the ordinary traveler misses in the Egypt of hotels and tourists' places. But they are part of the life Mrs. Grace Thompson Seton sees in her thrilling trips straight into the heart of the country.

Mrs. Seton told, in her radio lecture, of the political and social activities of the woman of Egypt. Told of her own adventures in a fierce simoon of the desert, when all the tents were blown away but hers. Of how her tent was held fast to the sand by a man lying at each peg, tamping, tamping, tamping, all the night through.

The talk was a treat. But it had another interest quite outside itself. For it all grew out of an idea. It was the idea of Miss Anita Browne, Chairman of the Radio Committee of the League of American Penwomen. The League has a big, definite purpose, which it carries out in a big, efficient way. Part of that way, now, is by radio.

The League of American Penwomen, in case you do not know it, is a league of successful professional women. It has branches in twenty cities all over the United States. An important part of its purpose is to extend to young students the encouragement and help that will develop their abilities and show them the way to professional advancement.

Members who have gained fame as writers, lecturers, artists, musicians, give talks and conduct study groups for student members. There are poetry groups and short story groups, drama, scenario writing, music and art. All under well known women who generously give their time.

Now, through radio, the delightful entertainment of some of these groups, and the message of practical help and scholarships offered, will reach thousands who never before heard of the League of American Penwomen.

For the League's first radio evening Mrs. Grace Thompson Seton stepped out of a most impressive page of "Who's Who" to give her talk from WJZ. Mrs. Seton is vice-president of the National League and finds time in a busy life to serve generously in its activities.

That was the first talk. Then later in December, Mrs. Alice McKay Kelley spoke on "Christmas in the Philippines." Soon there will be more talks, from other stations, too, in different parts of the country, as the radio committee enlarges its range.

The idea of this radio committee, as an effective way to spread the impulse to creative inspiration among young writers and artists presupposes, of course, a large audience of women listeners everywhere.

When you cannot see beyond the microphone—when you cannot sense your audience—how can you know that women are listening-in the country over?

The question was put to WJZ. And the answer was in the letter files. There were hundreds of letters from women—perhaps thousands, if you counted them. Some of them are responses to talks specially planned for women—intelligent inquiries on the subjects discussed. Some of them are bits of enthusiasm or criticism.

The letters give real glimpses of home fun everywhere, and gradually shape, by the force of public opinion, the trend of broadcasting. Remember, there is no box office to indicate what the public wants—only the letters you send. And the woman's vote is as weighty as the man's.

What does the woman like, when she listens in? So far, you can only throw up your hands in despair at the puzzle. Read some of the letters that come to a single station—and you say, "Everything!"

One woman likes jazz music. Another wants less jazz and more classical music. One thinks prize fights are "just too brutal for words." Another writes to suggest that Major White be surrounded by a sort of telephone booth from which to talk, so that the cheers of the crowd can't drown a word of the broadcasting of the big fights.

A list of the things that "I especially

liked," copied from letters of women everywhere, includes the Hotel Commodore Orchestra, an organ recital, the Coast Artillery Band, a negro quintette, a sermon, a prize fight, bedtime stories, dinner speeches, stories of travels in Africa, violin solos, interior decoration talks. Almost everything on the broadcasting program.

One woman writes:

"My mother-in-law wants to know if you'll kindly try and play 'Beautiful Isle of Somewhere' on your wonderful organ."

And another:

"Please have just lots of dance music and please have the Blue Ribbon Syncopators again.

"Dorothy."

But the most universal picture is a home picture, with all the family listening-in—everybody applauding. Letters are signed "Mr. and Mrs. So-and-So." Or "The So-and-So Family." All together, they listen-in to the games. Mother acquires an eager interest in the sports her boys are following and soon becomes a baseball or a football fan. Sometimes she notes down the market reports and weather reports, for her farmer husband, to guide in his day's work, or the marketing of his products.

Here is a letter that gives a glimpse of the way radio quickly takes its place in the family circle. It came in response to the broadcasting of a Boy Scouts' program:

"You know I am a great friend of the Scouts. I have a boy, he belongs to the Scouts, and I never let him miss a meeting. It took two years for me to decide to have a radio set, but I certainly am not sorry; it passes our evenings away, the only trouble is we stay up too late. My husband always says just this one, but it's never the last one until late, but never mind, it's all right."

Many and many a letter comes in to tell of the helpfulness of lecture and sermon to women everywhere. One woman who never heard a lecture in her life found her comparative deafness overcome by the close-fitting headphones, and no longer misses the big news and the interesting speakers. The letters of listeners to the sermons are too many to quote. Here is one written to WGY that tells a story that is universal:

"Please accept our thanks for the privilege of listening to the church service this morning. Especially thankful is one member of our family—Mother Forrester, 73 and blind for the past ten years, weak from afflictions and unable to go out of the house to a service on Sunday for the past five years. She was an ardent Episcopal Church member in the past and sincerely hopes many other shut-ins have had the same good fortune to have listened-in this day."

And here's another letter:

"I drove 34 miles on Sunday to get a set working so the lady of the house could hear the afternoon sermon. After we got the set working, I wish you could have seen the expression on her face. This party is paralyzed and can't leave the house."

Women are critical—critical of the quality of the music, whether it is quality of jazz, or quality of classical music. They are critical, too, of the talks and lectures. There is always an audience for every type of program, but gradually the popular interest appears, shown in the type of criticism, and the number of letters of appreciation received.

A good example of the radio talk especially planned for women—a series with, presumably, a large audience—is the group of talks by Miss Harford, of "Harper's Bazaar." No man can quite appreciate the interest in the first news from the front—the front being Paris. "Harper's Bazaar" prints the fashion news "almost as soon as Paris knows it." And the radio talks tell that news often before the magazines are on the stand. What a scoop!

(Above). Black shaved lamb jacket worn over plaid frock shown at left.

Fresh Paris fashions are radioed from "Harper's Bazaar"

Take the three-piece suit, for example, with the three-quarter length coat. First news of its coming fashion importance was the sketch here reproduced from "Harper's Bazaar." But the news was permitted to leak out, first, by radio.

It is difficult to know who is listening-in, for there is no occasion for letter-writing, when the questions are answered in the talk. But sometimes a designer will stop in to ask Miss Harford to tell more than her brief lecture can reveal. Or a busy dressmaker, whose receiving set was not functioning clearly, comes to the magazine office to ask the names of the Paris-sponsored fabrics broadcast that week. Miss Harford welcomes these questions—and welcomes all letters—for they quickly show what sort of talks are most useful. And that is what she wants to know.

The future of broadcasting programs will be determined by the audience—and a large part of it by the feminine audience. "Give the woman what she wants," is the slogan. It's a hard enough task at best, as any man will tell you. How much harder, if you don't write, write, write!

Lucky Mayors!

IT is too bad that it is such a job to incorporate a city, otherwise probably about 99.44% of the American people would endeavor to become mayors. The reason is that the mayors of San Francisco on the Pacific Coast and New York City on the Atlantic Coast, have each been given a radio set. During their visit to San Francisco, last spring, Major General James G. Harbord and David Sarnoff, president and vice president of the Radio Corporation of America, discovered that Mayor Rolph of San Francisco had to use headphones when he listened in, using a set in his office. The Mayor now uses a Radiola Grand presented to the city by General Harbord. In New York City, Mayor Hylan also has been given a similar receiver.

From the Skies

MR. RIDOUX, an amateur of Garches, France, had the luck recently to find a meteorite weighing a number of pounds. In breaking it he noticed a number of sparkling particles, resembling the appearance of galena. A small piece of the visitor from the heavens was forthwith inserted in the crystal holder, the cat whisker adjusted—and signals heard. The material proved to be only slightly inferior to regular galena, but seemed to contain fewer sensitive points.

The Navy's Radio Net

135 Land Stations
More than 400 Ship Stations
$25,000,000 of Installation and Equipment
100,000,000 Words Transmitted Annually

"All's Well: Radio is at the Helm"

By J. Farrell

"PLEASE send destroyers, Yokohama. Americans in great distress—Bell." It was one of the early messages of the Japanese disaster, sent by Commander Bell in charge of the Naval Hospital at Yokohama from a Japanese warship, and received at San Francisco via Shanghai, the Philippines, Guam and Honolulu. The Asiatic fleet was at once dispatched to the scene to render aid to the sufferers. When Smyrna was burning, it was an American naval vessel that told the world by radio of the disaster. Help was summoned from all over the seas, and the American Navy saved thousands of Christian lives.

Visualize 135 radio stations dotting the Atlantic, Gulf and Pacific Coasts, and the island possessions of the United States. Add to the system more than 400 floating stations on as many naval vessels on the high seas. The result is a picture of Uncle Sam's vital nerve force without which in time of war the American Navy would be an unwieldly mass, and in time of peace ineffectual in protecting America's foreign commerce, in preventing maritime disaster, and in bringing succor to the distressed in shipwreck, earthquake, plague and famine. The navy's radio net covers practically the entire world.

In protecting America's commercial interests abroad, radio has played a large part in directing the movements of naval vessels that patrol foreign waters. In the West Indies, for example, the navy has frequently landed men to protect the hemp, oil and fruit trade; in Cuba similar protection is afforded American sugar plantations; in the Near East the tobacco and petroleum trade on occasion have needed protection from local uprisings. The powerful radio station at Peking enables the Admiral of the Asiatic Fleet to keep in close touch with the American Legation, and to render prompt aid in protecting life and property from bandit hordes. Similar assistance is rendered at Constantinople.

Monster radio antennae of the U. S. S. Colorado, the world's greatest battleship

Every navy station is required by official order to listen for a period of three minutes every fifteen minutes for signals of distress on the high seas. When such a signal is heard the call, together with the position of the vessel, is broadcast on high power. Every naval unit in the vicinity of the disaster is rushed to the scene, directed from shore and ship by radio. Storm warnings are regularly flashed from the high powered shore stations covering a range up to 6,000 miles. The radio compass stations, of which there are more than 50 located at strategic points along the American coasts, have been the means of preventing heavy loss of ships and life in time of fogs, and other maritime emergencies.

The navy radio system is generally conceded to be the most comprehensive anywhere in the world. Along the coastal boundaries of the United States and island possessions there are 40 high power stations that work distances from 800 to 6,000 miles. These stations are supplemented by 95 intermediate stations with ranges up to 800 miles. Combined with the 400 or more ship stations and airplane radio equipment, the complete land, sea and air radio system represents an investment of approximately $25,000,000. The interplay of messages between stations aggregates 100,000,000 words annually. Most of the business is of a government or public nature, but 68 stations are also permitted to be used for commercial business by ships at sea. These stations handle an annual volume of 5,000,000 words.

The complete system is primarily organized as part of the nation's naval defense. "But in time of peace," declares Rear Admiral H. J. Ziegemeier,

The radio equipment of the new U. S. Navy airplane carriers includes the novel feature of two collapsible radio masts

Scout Cruiser "Detroit" hitting out for sea with all antennas spread

"the service has many ramifications. By extending a liberal use of the system to the press and business where it does not interfere with commercial companies, peoples all over the world are brought into closer contact and human understanding. Another important activity is to assist mariners by flashing out time signals, weather reports, storm warnings, hydrographic reports, and in transmitting S O S and signals of distress."

During the winter months the Alaska cable is frequently broken. In these emergencies naval radio provides the only means of rapid communication between Alaska and Continental United States. To handle the messages, stations are located at Sitka, Ketchikan, Seward, Kodiak, Cordova, Dutch Harbor and St. Paul in Bering Sea. Similarly, only one cable connects the United States with the Far East and is frequently out of commission months at a time due to coral formations on the bottom of the sea between Guam and Manila. To make up this lack the navy has several radio circuits across the Pacific, the giant of which is from San Francisco to the Philippines.

Navy stations are located at Honolulu, Guam and Cavite, and Tutuila in the Samoan Islands. The Cavite station is in sonstant communication with French Indo-China and the Dutch East Indies. Northward from Cavite are the circuits to Peking and Shanghair. Eastbound traffic is sent direct from Cavite to San Francisco. During the Limitation of Armament Conference two special circuits for government and press dispatches were set up between the United States and Japan. The northern circuit was between the Japanese radio station at Sapporo and the navy station at St. Paul. The southern circuit was used for one way traffic, Honolulu to Iwaki, and is still used for westbound messages. The Samoan circuit is made available for traffic to the Society and Fiji Islands, as well as to New Zealand and Australia.

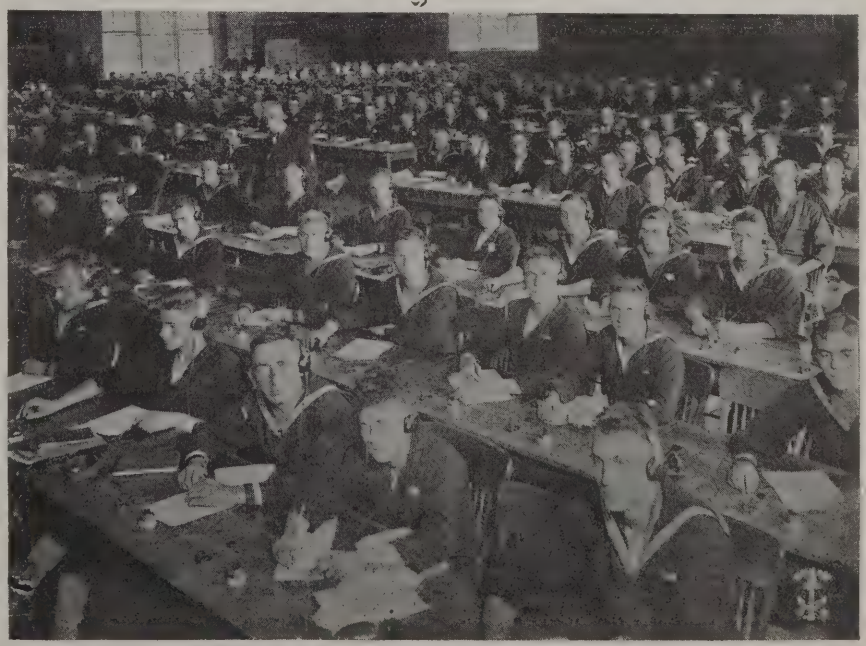
In the Pacific the navy is permitted by law to handle press reports to practically any point, provided that one end of the deal is connected with American newspaper interests. This authority expires June, 1925. Under it news services in the Pacific are handled by the navy, the Associated Press sending an average of 1,000 words daily from San Francisco to Honolulu and about 800 words to Manila. The navy press rate to Honolulu is three cents a word and six cents a word to Manila. The navy handles all radio communications with the Philippines. Privately owned stations are not permitted to operate on the Islands.

On the eastern coast of the United States the main navy stations are at Bar Harbor, Maine; Sayville, L. I.; Annapolis, Md.; Arlington, Va.; Cayey, P. R.; Guantanamo, C. Z. and Panama. Bar Harbor is a receiving station for messages from Europe, the fleet in the West Indies and from the Pacific. Sayville is used as a transmitting station to the fleet and as a standby for Annapolis, both stations being operated by remote control from Washington.

During the troubles in the Near East, communication with the Admiral at Constantinople was had through Annapolis to Paris, leased land line to Coblenz, Germany, thence to Vienna, from Vienna by radio to a naval vessel in the Mediterranean, thence relayed by radio to Constantinople where the navy has a receiving station at the American Embassy and also a ship station. The return messages were similarly handled, being received at Bar Harbor, and then telegraphed by land line to the Navy Department at Washington. In later experiments, messages have been copied direct from Annapolis by the ship station at Constantinople.

The radio compass developed by the navy is regarded as the navy's outstanding contribution to the safety of navigation. A compass station is located within 100 miles of every important seaport in the United States. Storms frequently drive mariners 50 to 100 miles off their course, and in the ensuing cloudy or overcast weather

(*Continued on page* 68)



NAVAL RADIO SCHOOL AT GREAT LAKES

Here the raw "gobs" are made into radio technicians who hold the key to the Navy's nerve system

When Marine Radio Reports Were Tabooed

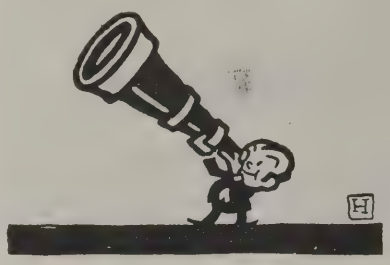
By Old Timer

STRETCHING northward towards New York City from the New Jersey coast which is dotted with merry and populous seashore resorts, there is a bleak, barren, sandy, narrow and generally unattractive neck of land known as Sandy Hook. At first glance one would say that this bit of land, several miles in length and but a fraction of a mile wide, is of no use whatsoever. Yet, jutting out into the ocean and embracing in its wide sweep a sheltered body of water which forms part of Lower New York Bay, Sandy Hook could not have been better designed for two purposes. It is ideal as an observation post for keeping tabs on incoming and outgoing shipping clearing the Port of New York.

Back in 1909, when radio communication had not been developed to its present high state of efficiency, there stood on the very tip of Sandy Hook a pair of tall towers. From some distance away, they seemed twins in architecture as well as in purpose; but when viewed at close range they were quite different. One tower was built of steel, while the other was built of wood; however, both towers were surmounted by small balconies and a complete circle of windows for facilitating observation out to sea. A keen observer could not fail to notice one or more long barrels protruding from the windows and balconies, which, in view of the military surroundings, might well be mistaken for machine guns or young cannons. But as a matter of fact they were merely telescopes of high power.

Now these towers were maintained by two rival telegraph companies for the purpose of reporting the ships passing Sandy Hook. The rivalry was of the keenest sort, for the telegraph companies secured patronage for their marine news service largely on the basis of their "scoops." In each tower there were several men on duty, ever on the lookout for signs of smoke on the horizon and ever ready with their powerful telescopes to identify the incoming ships by their funnels and superstructure. The instant a ship was identified, a report would be flashed by telegraph to the marine news bureau in New York City. For that purpose a battery of keys and sounders surrounded the observers in each tower.

The way the writer happened to come across the story which he is about to narrate was through a series of radio telephone tests then being conducted between Fort Hancock, Sandy Hook and Fort Wood, Bedloes Island, in the very shadow of the Statue of



Liberty and the very station from which the WVP radiophone programs have been broadcasted. The small Army boats plying between New York City and Fort Hancock are few and far between, and since the radio telephone experiments at that time never lasted longer than a few hours at a time—it was an ordeal at that period, rather than a pleasure—the writer found himself with plenty of time on his hands and not much to do. Hence in the course of his walks about the narrow strip of land, in which every feature of the military post had become quite commonplace and without further interest except for the big guns, and these had to be viewed from a distance because of the snappy sentries, the author quite naturally discovered the two towers and spent much of his time in one of them. And that is how he obtained the data for this little story.

Now it appears that the keen rivalry between the two observation towers led to more and more guesswork as regards the reporting of shipping, as might well be expected. At first the observers waited until a ship was well above the horizon, so that she could be viewed in her entirety without chance for mistaken identity. But with the ever-increasing urge for "scoops" the observers began to identify ships by means of their superstructure and funnels, the latter being generally of a characteristic color or design.

Then one of the observers hit upon the novel and bold scheme of utilizing radio. He installed a radio receiving set in his tower and was able to hear the ships reporting to Fire Island, some forty miles distant. Once the ships reported to Fire Island, it was a simple enough matter to compute the time required for the ship to come to the horizon of Sandy Hook. So in a short time the observer in question began to identify and report his ships as soon as a bit of smoke appeared on the horizon, while his rivals, in the other tower, had to wait several minutes longer until the funnel and superstructure of the ship came into plain view of the powerful telescopes. Obviously, our observer scored one "scoop" after another until the rival telegraph company must have been on the verge of panic; for how could the super-vision of the rival observers be accounted for?

Then one day the unexpected happened. After scoring one "scoop" after another until it became an established fact and no longer created wonder, our observer friend reported a ship by means of its smoke in the usual way. He had told the rival observers that he had developed a new method of identification by means of the smoke of the various ships, much to their incredulity yet leaving them very mystified as to the peculiar powers of our observer.

A bit of smoke marred the horizon, whereupon our observer friend telegraphed the report in the usual manner. He had heard the ship reporting to Fire Island an hour or more ago, and it was just a matter of routine. But when the ship came closer, our observer discovered, to his horror, that he had made a mistake. The ship, instead of being the ocean liner which he had reported, was a coastwise steamer which was swinging in from a course far out to sea. He had to telegraph a correction—a fatal thing in this line of reporting. The officials of his company, now aroused to the fact that some peculiar and quite fallible method must be at work in identifying ships by means of their smoke, investigated and discovered the radio receiving set.

4,500,000 Miles, Some Record!

Radio Signals Make Automatic Return

ENGINEERS of the Radio Corporation of America achieved a scientific feat recently, when by an arrangement of the controlling circuit of the longest commercial radio service in the world—New York to Warsaw, Poland—they were enabled to make automatic signaling a substitute for operators. Radio was made to control radio, and thus over an 8,500-mile circuit continuous signaling was produced without human assistance.

The experiments were conducted before General J. G. Harbord, President of the corporation, at 66 Broad Street. W. A. Winterbottom, traffic manager, was in direct charge, while at the Warsaw terminal a special squad of engineers of the company was present.

At noon, when the experiment was begun, telegraph signals looped the loop around the circuit of the two radio stations with the speed of light. Unassisted by operators, relays of radio waves continued for twenty-five seconds and covered a total distance of 4,500,000 miles (twenty times the distance to the moon) under automatic control that was initiated by the original impulse.

One can visualize this performance as a gigantic radio lasso, set in motion by a short impulse which entered the transmitting control apparatus and shot forward the first wave, successive waves automatically being released to loop repeatedly about the Warsaw station and Broad Street.

Again and again this original dot raced around the circuit without interference from man. After making forty laps around the course, passing through twenty-five vacuum tubes, ten relays, changing its wavelength eighty times—first a feeble line current, then a mighty electrical wave—the automatic sequence set in operation by the initial impulse became completely exhausted and the dot withdrew from the race. And all this happened in twenty-five seconds.

In other words, the original radio impluse unaided by man caused a signal to travel back and forth around the loop made up of wire telegraph lines and radio circuits at the rate of 186,000 miles per second, and since it continued this process for twenty-five seconds, it actually covered the astounding distance of about 4,500,000 miles.

Explaining the commercial significance of this scientific achievement, General Harbord said:

"We have thus achieved a double check in communicating by radio over our Warsaw circuit. Today's experiment makes it possible for us to know in an instant the condition of our circuits. The accomplishment means that messages can be checked as to proof of their receipt and accuracy almost instantaneously with their sending. In fact, we are able to know as much about the condition of the Warsaw circuit as the engineer there."

That Radio Jag

SOME English clergymen think that radio is enough to drive a man to drink. At least, that's the natural conclusion to draw from the fact that in Nottingham the ministers have protested to the authorities against the installation of radio receiving sets in the "public houses," or saloons. The saloon keepers are hurt and indignant, saying that they are trying to elevate the tone of their establishments by means of the radio programs, but the ministers insist that it is but an insidious and evil scheme to get the workingmen to drink more and more.

WE HAVE A SPECIAL ANNOUNCEMENT.

"A young man has been granted the privilege of broadcasting for ten minutes on a subject distinctly personal. It is not our custom to give permission for such a talk requested by a private individual, whose identity we cannot reveal. There are special circumstances in this case, and we hope you will bear with us, and listen to what Mr. I. W. A. J. as he prefers to be known, has to say. Mr. I. W. A. J."

Eric H. Palmer contributes to the February issue an unusual dramatic story of what I. W. A. J. broadcasted. The reader will stay with it to the end to find out what three leading men of Gotham did about I. W. A. J.

Our women readers and lots of other folk will welcome some information on how to house their radio sets in appropriate and artistic manner. Mr. William A. Hurd writes in the February number an illustrated article about the various styles of radio furniture.

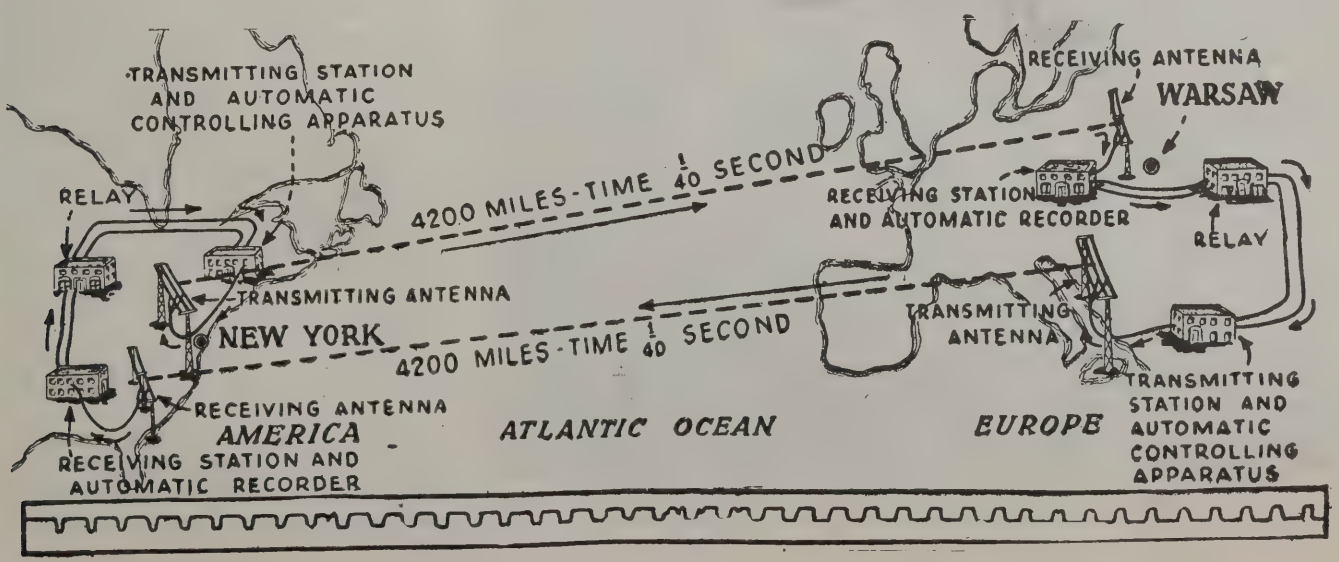
THE WIRELESS AGE REFLEX

Mr. John R. Meagher gives the readers of our February number an easy-to-make tuned R. F. reflex receiver that will be a worthy addition to the series of Wireless Age sets which include the "Push Button" receiver of this number and the "Uni-Control" of December. It costs about $10.00 to make this one-tube set which will operate a loud speaker at a range of 20 miles and has been proved for DX up to 1,500 miles.

Every radio fan wants to know about vacuum tubes—the different makes and their characteristics, what uses the different tubes are best adapted to and how to use them properly. The editor of THE WIRELESS AGE presents this information in a clearly understood article entitled "ALADDIN'S MAGIC LAMP" in the February number.

FOR THE BEGINNER IN RADIO

In February THE WIRELESS AGE commences Radio Engineering, an experimental home laboratory course in which the elements of radio will be presented in scientific but readily comprehended talks.



Peeps into Broadcast Stations

KYW Again Broadcasting Grand Opera Productions

RADIO fans who are music lovers will welcome the broadcasting by KYW, Chicago, of grand opera productions which began November 10th, when "Lucia Di Lammermoor" was sung.

The principals who sang Donizetti's beautiful score are: Giacomo Rimini, baritone; Florence Macbeth, soprano and Giulio Crimi, tenor, with Jose Mojica, Virgilio Lazzari, Elizabeth Kerr, and Lodovico Oliviero, singing in the lesser rôles.

The broadcasting of grand opera from KYW, Chicago, last year, when such brilliant voices of internationally famous stars such as Galli-Curci, Rosa Raisa and Mary Garden were heard over a goodly portion of the world, was a great accomplishment. The grand opera season last year was broadcast twice weekly during the ten weeks' engagement of the Chicago Civic Opera Association and the concerts were enjoyed by audiences which numbered more than a million.

The delight with which radio fans hailed this innovation was proved by a deluge of letters which came from every part of the country. These letters, many of which came from distant points, indicate that this development has served to bring residents of out-of-the-way and remote sections into close touch with culture, education and music, so that soon there will be little to differentiate the city dweller from those who live in the rural districts.

The grand opera productions were broadcast by means of a special sealed telephone wire connecting the stage of the auditorium with station KYW, which is located on top of the Edison Building, twenty stories above the busy Loop district.

PRINCIPALS OF "GO-GO" AT WGY
One reason it is worth while to Peep Into a Broadcast Station

Reconstruction of CFCN

COMPLETE reconstruction of CFCN, the radio broadcasting station of the W. W. Grant Radio, Ltd., at Calgary, Alberta, Canada, has now been completed and CFCN is now listed as one of the most powerful stations on the American continent and the most powerful in Canada, having a modulating output power of 1,600 watts. It is now an eight and one-half kilowatt station.

"The Voice of the Prairies" was silent for two weeks while new equipment was being put in place, but when it resumed activities the added power and clarity of its signals startled radio fans throughout the United States and Canada, according to telegrams and postal communications of congratulation which commenced to pour in two days after the reopening. President Grant has stated that on the rejuvenated set he hopes to shatter some of the long-distance records he has established in the two years which CFCN has been in operation.

Twelve especially manufactured tubes of 500 watts each, made in Montreal, are now being used, while a new amplification unit designed and constructed by Mr. Grant is also being utilized to advantage.

The building from which emanates the "Voice of the Prairies" also has been made more capacious, so that now there is an abundance of room for artists, and it has been announced that programs from CFCN in the future will be supplied only by artists engaged by it.

IN THE TRADE-WINDS' CLIME
West Indies

This Is WKAQ, San Juan, Porto Rico

BROADCASTING Station WKAQ is located in the center of the city of San Juan, Porto Rico. Its owner The Radio Corporation of Porto Rico is affiliated with the International Telephone and Telegraph Corporation of New York, as is its sister station PWX at Havana, Cuba. The first broadcasting of WKAQ was done on August 26, 1922. The entire plant is installed on the top floor of the Porto Rico Telephone Co.'s seven-story building. The view from the towers, overtopping all the buildings of the city, gives a good impression of the progress of this island in every phase of civilization. On the roof of the telephone building a steel tower 87 feet high supports one side of the three-wire antenna that runs 90 feet horizontally to another tower 187 feet above the street level. The lead-in comes from the center giving a "T" type aerial.

The announcer in this particular station is the program manager and the general manager of the corporation. The announcer gives a few suggestions to the artist and moves the microphone to the proper place, opens the switch and announces: "This is WKAQ, Radio Corporation of Porto Rico, San Juan, Porto Rico, the Switzerland of America, where the best coffee grows. The next number on our program for tonight will be . . . One second please." This is repeated again in the Spanish language.

WKAQ has been heard in every state of the Union, Canada, West Indies, Mexico, Central and South America. Although the station broadcasts twice a week (Tuesday and Friday, from 9:00 to 10:30 p. m.) Porto Rico time, which is one hour later than 75 meridian time and four hours later than Pacific time, many letters have been received from California, Oregon and Washington, reporting reception of WKAQ during daylight.

Late Concerts From WBZ

PURSUING its policy of innovation in broadcasting and of service, station WBZ has arranged "late hour" programs. The purpose of these programs is to entertain the radio fans who are not at home in the earlier part of the evening, and to give fans located far away, particularly in the Middle West, a chance to listen to the Springfield station.

These late programs take place each week, on Wednesdays and Fridays, beginning at 11:00 P. M. On those evenings, WBZ is silent from 8:00 until 9:00 P. M. This arrangement is of course tentative, but will be continued if it receives the approval of the radio audience. The first late hour program was broadcast October 31.

The popular WBZ Trio, whose concerts have been enjoyed by thousands for the past few months will be augmented on "late hour" broadcasts with a clarinet and a flute, thus composing what will be known as the WBZ Quintette.

As will be remembered, the original trio consisted of a cello, violin and piano. It will retain its original form on Monday nights, but it will play compositions of its own on the nights when the additional instruments will reinforce the group of players.

In addition to the quintette, a soloist will take part in the evening's entertainment of the Wednesday and Friday late hour chamber music programs. This will afford a pleasing variety of music and will be well worth while staying up to listen to.

These late hour concerts are booked in response to requests from distant listeners, located especially throughout the middle west. As the station ordinarily completes its programs at about 9 o'clock, distant fans who begin listening at about this time, cannot hear it. Many local fans do not turn to their sets for radio entertainment until late in the evening. Giving programs at the period of from 11:00 to 12:00 P. M. eastern standard time should please both near and far away listeners.

HITCHY-KOO

RAYMOND HITCHCOCK
In Person
Doing his stuff at WGY. And the best part of it is, it looks just like him

Up–E–Nuf

WOC, Palmer School of Chiropractic

HOUSED in specially fitted rooms located on Up-E-Nuf, the roof auditorium of the school, the broadcasting apparatus and the studio equipment of WOC constitute the last word in modernity.

This station has been heard in Hilo, Hawaii, and officially reported as having been heard in Stockholm, Sweden.

Val McLaughlin brings the sandman to the kiddies each evening. The "Sandman's Visits" are chosen to please children from two years up to ninety, and include every kind of story, rhythmic poetry, nature, realistic and fairy tales. The fairy stories particularly appeal to the children between twenty-five and eighty-five or ninety years old, judging by the letters received.

Stanley W. Barnett, program director, is known as announcer BWS. The artist caught his pose just as he was about to make the opening announcements on one of the evening programs. Except for his shirt sleeves, Barnett is wholly informal in the conduct of the studio affairs.

On the other hand, Erwin Swindell, musical director, can hardly take things so lightly. Balancing wild jazz syncopation with a variety of classical numbers, solos, and orchestral renditions is no mean job.

WOC has received in one week as many as 12,000 communications from listeners-in within a radius of 4,000 miles. A telegram was received that read: "Radio broadcasting is the symbol of unselfishness."

The Personality of a Broadcasting Station

By Lloyd Jacquet

AS I sit at my faithful radio receiving set at this moment, listening to the whisperings of a continent, a twist of the dial brings to me the delightful concert from a favorite station. I have listened several minutes to a flute solo, and as the selection ends, I find myself applauding. I have enjoyed the music thoroughly.

It occurs to me suddenly, as I await the next number on the program, that I have known that station a long time. It is like an old friend, which beckons to me, and which responds willingly to my nightly call. It is a living thing, with a voice, and a personality. It has a name, it sings, it talks, it plays. It has a very definite entity, and characteristics which permits one to identify it instantly from among hundreds of others.

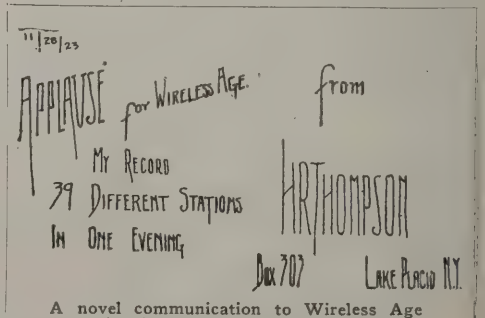
Then, I feel as though this station had grown very dear to me. Every evening, I "tune it in," certain to find some kind of entertainment which will provide me with an evening's recreation. It is just what I need after a hard day's work. And in a peculiar uncanny way, the station seems to guess the sort of program which I would like to have, and it fits my peculiar moods and feelings that evening. What a wonderful and sympathetic pal it has grown to be!

Of course, there are many other stations to which I like to listen. Some evening, I miss one of the many voices, those voices from the ether, more ghostly than the most realistic of spirits. Another station has been discontinued. Another voice has been stilled. It seems that, as with a living thing, something has died. I have heard stations pass out of the brilliant ether firmament, quietly, mysteriously, almost noiselessly. Whither have they gone?

And I have been wondering what this quality or sentiment can be, that something which attaches us to these voices, which are, after all nothing more than a mass of wire, batteries, and coils. What impels us, night after night, to turn the dial of the receiving apparatus to the same point, and to listen attentively for whatever station our desire has chosen for entertainment that evening? What makes us turn to that favorite station, when we have listened to dozens of others, East and West, and North and South? It is indeed a difficult thing to determine. But it must be something very akin to the instinct which prompts us to seek a particular friend from among many in a desire to share our joy, or to impart a secret.

I have been thinking also, as I turn the dial of my receiving set to further explore the wide expanse of the ether that I have not been treating this favorite station of mine right. I know that every human being likes to be encouraged, and wants to be told when something has caused much pleasure. I have been listening to this station for

(*Continued on page* 68)



A novel communication to Wireless Age printed on the back of a postal

BROADCASTING STATION DIRECTORY

(Revised to December 15th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony, Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co., Spokane, Wash.	283
KGB	Tacoma Daily Ledger, Tacoma, Wash.	252
KGG	Hancock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co., Portland, Ore.	360
KGU	M. A. Murrony, Honolulu, Hawaii	360
KGW	Oregonian Pub. Co., Portland, Ore.	492
KGY	St. Martins College, Lacey, Wash.	258
KHJ	Times Mirror Co., Los Angeles, Calif.	395
KHQ	Louis Wasmer, Seattle, Wash.	360
KJQ	C. O. Gould, Stockton, Calif.	360
KJR	Northwest Radio Service Co., Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop, Monterey, Calif.	261
KLS	Warner Brothers, Oakland, Calif.	360
KLX	Tribune Publishing Co., Oakland, Calif.	360
KLZ	Reynolds Radio Co., Denver, Colo.	360
KMC	Lindsay-Weatherill & Co., Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co., Tacoma, Wash.	360
KNT	Grays Harbor Radio Co., Aberdeen, Wash.	263
KNV	Radio Supply Co., Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept., Detroit, Mich.	286
KOQ	Modesto Evening News, Modesto, Calif.	360
KPO	Hale Bros., San Francisco, Calif.	423
KQI	University of California, Berkeley, Calif.	360
KQP	Apple City Radio Club, Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co., Pittsburgh, Pa.	360
KQW	Charles D. Herreld, San Jose, Calif.	360
KRE	Berkeley Daily Gazette, Berkeley, Calif.	278
KSD	Post-Dispatch, St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church, Seattle, Wash.	360
KUO	The Examiner Printing Co., San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co., El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner, Los Angeles, Calif.	360
KXD	Herald Publishing Co., Modesto, Calif.	252
KYQ	Electric Shop, Honolulu, T. H.	360
KYW	Westinghouse Elec. & Mfg. Co., Chicago, Ill.	536
KZM	Preston, D. Allen, Oakland, Calif	360
KZN	The Desert News, Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio.	270
KDPT	Southern Electric Co., San Diego, Calif.	244
KDLY	Telegram Publishing Co., Salt Lake City, Utah	360
KDYM	Savoy Theatre, San Diego, Calif.	252
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYS	The Tribune, Inc., Great Falls, Mont.	360
KDYW	Smith, Hughes & Co., Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co., Honolulu, T. H.	360
KDZB	Frank E. Siefert, Bakersfield, Calif.	240
KDZE	Rhodes Company, Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co., Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co., Reno, Nev.	360
KDZQ	Pyle & Nichols, Denver, Colo.	360
KDZR	Bellingham Publishing Co., Bellingham, Wash.	261
KDZT	Seattle Radio Association, Seattle, Wash.	360
KDZU	Western Radio Corporation, Denver, Colo.	360
KDZV	Cope & Cornwell Co., Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington, Pullman, Wash.	360
KFAF	Western Radio Corporation, Denver, Colo.	360
KFAJ	University of Colorado, Boulder, Colo.	360
KFAN	Electric Shop, Moscow, Idaho	360
KFAP	Standard Publishing Co., Butte, Mont.	360
KFAR	Studio Lighting Service Co., Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue, Eugene, Ore.	275
KFAU	Independent School District of Boise City Boise, Idaho	270
KFAV	Abbot Kinney Company, Venice, Calif.	258
KFAY	W. J. Virgin, Medford, Ore.	283
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFBB	F. A. Buttrey & Co., Havre, Mont.	360
KFBC	W. K. Azbill, San Diego, Calif.	360
KFBE	Reuben H. Horn, San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co., Sacramento, Calif.	283
KFBL	Leese Bros., Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas, Laramie, Wyo.	283
KFCD	Salem Elec. Co., Salem, Ore.	360
KFCF	Frank A. Moore, Walla Walla, Wash.	360
KFCH	Electric Service Station, Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCM	Richmond Radio Shop, Richmond, Calif.	360
KFCP	Ralph W. Flygare, Ogden, Utah	360
KFCQ	Motor Service Station, Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr., Houston, Tex.	360
KFCY	Western Union College, LeMars, Iowa	252
KFCZ	Omaha Central High School, Omaha, Nebr.	258
KFDA	Adler's Music Store, Baker, Ore.	360
KFDB	Mercantile Trust Co., San Francisco, Calif.	509
KFDD	St. Michaels Cathedral, Boise, Idaho	360
KFDF	Wyoming Radio Corp., Casper, Wyo.	360
KFDH	University of Arizona, Tucson, Ariz.	360
KFDJ	Oregon Agri. College, Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co., Denver, Colo.	360
KFDO	H. E. Cutting, Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson, Fayetteville, Ark.	360
KFDX	First Baptist Church, Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brookings, S. D.	360
KFDZ	Harry O. Iverson, Minneapolis, Minn.	231
KFEC	Meier & Frank Co., Portland, Ore.	360
KFEJ	Guy Greason, Tacoma, Wash.	360
KFEL	Winner Radio Corporation, Denver, Colo.	360
KFEP	Radio Equipment Co., Denver, Colo.	240
KFEQ	J. L. Scroggin, Oak, Nebr.	360
KFER	Auto Electric Service Co., Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop, Douglas, Wyo.	263
KFEX	Augsburg Seminary, Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs., St. Louis, Mo.	360
KFFE	Eastern Oregon Radio Co., Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co., Boise, Idaho	360
KFFQ	Dr. E. H. Smith, Hillsboro, Ore.	229
KFFQ	Markschoffel Motor Co., Colorado Springs, Colo.	360
KFFR	Jim Kirk, Sparks, Nev.	226
KFFV	Garceland College, Lamoni, Iowa	360
KFFX	McGraw Co., Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc., Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co., Dallas, Tex.	226
KFGC	Louisiana State University, Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co., Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co., Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ., Stanford Univ., Colo.	360
KFGJ	National Guards Co., 138th Inf., St. Louis, Mo.	266
KFGL	Arlington Garage, Arlington, Ore.	234
KFGQ	Crary Hardware Co., Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co., Utica, Nebr.	224
KFGX	First Presbyterian Church, Orange, Tex.	250
KFGZ	Emmanuel Missionary Co., Berrien Spgs., Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	The Rialto Theatre, Hood River, Ore.	280
KFHD	Utz Electric Co., St. Joseph, Mo.	226
KFHF	Central Christian Church, Shreveport, La.	266
KFHH	Ambrose A. McCue, Neah Bay, Wash.	283
KFHJ	Fallon Co., Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co., Seattle, Wash.	270
KFHS	Robert Washington Nelson, Hutchinson, Kans.	229
KFIB	Franklin W. Jenkens, St. Louis, Mo.	244
KFIC	Philip Laskowitz, Denver, Colo.	224
KFID	Ross Arbuckles Garage, Iola, Kans.	246
KFIF	Benson Tech. Student Body, Portland, Ore.	360
KFIK	Gladbrook Electric Co., Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School, Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIV	V. H. Broyles, Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ, Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories, Seattle, Wash.	236
KFIZ	Daily Commonwealth, Fond du Lac, Wisc.	273
KFJA	Central Power Co., Brand Island, Nebr.	244
KFJB	Marshall Electric Co., Inc., Marshalltown, Iowa	248
KFJC	Post Intelligencer, Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co., Oklahoma City, Okla.	252
KFJH	The Sugar Bowl, Selma, Calif.	273
KFJI	Liberty Theatre, Astoria, Ore.	252
KFJJ	Carrollton Radio Shop, Carrollton, Mo.	236
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJR	Ashley C. Dixon & Co., Stevensville, Mont.	258
KFJU	Central Power Co., Kearney, Nebr.	234
KFJV	T. H. Warren, Dexter, Iowa	226
KFJW	Le Grand Radio Co., Towanda, Kans.	224
KFJX	Iowa State Teachers College, Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co., Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College, Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co., Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories, Conway, Ark.	224
KFKV	F. F. Gray, Butte, Mont.	283
KFKX	Westinghouse Electric Co., Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson, Butte, Mont.	283
KFLB	Signal Electric Mfg. Co., Menominee, Mich.	248
KFLD	Paul E. Greenlaw, Franklinton, La.	236
KFLE	National Educational Service, Denver, Colo.	268
KFLH	Erickson Radio Co., Inc., Salt Lake City, Utah	261
KFLP	Everett M. Foster, Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop, Little Rock, Ark.	261
KFLR	University of New Mexico, Albuquerque, N. M.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	Rev. A. T. Frykman, Rockford, Ill.	229
KFLW	Missoula Electric Supply Co., Missoula, Mont.	234
KFLX	George R. Clough, Galveston, Texas	240
KFLY	Fargo Radio Supply Co., Fargo, N. D.	231
KFLZ	Atlantic Automobile Co., Atlantic, Iowa	273
KFMQ	University of Arkansas, Fayetteville, Ark.	263
WBL	T. & H. Radio Co., Anthony, Kans.	261
WBS	May & Co., Newark, N. J.	360
WBT	Southern Radio Corporation, Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCE	Findley Electric Co., Minneapolis, Minn.	360
WCK	Stix-Baer-Fuller, St. Louis, Mo.	360
WCM	University of Texas, Austin, Texas	360
WCX	Detroit Free Press, Detroit, Mich.	517
WDM	Church of the Covenant, Washington, D. C.	360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush, Tuscola, Ill.	278
WEB	Benwood Co., St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co., Houston, Tex.	360
WEW	St. Louis University, St. Louis, Mo.	261
WFI	Strawbridge & Clothier, Philadelphia, Pa.	395
WFY	Cosradio Co., Wichita, Kans.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett, Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co., Buffalo, N. Y.	319
WGV	Interstate Electric Co., New Orleans, La.	360
WGY	General Electric Co., Schenectady, N. Y.	380
WHA	University of Wisconsin, Madison, Wisc.	360
WHB	Sweeney School Co., Kansas City, Mo.	411
WHK	The Radiovox Company, Cleveland, Ohio	360
WHN	Loew's State Theatre, New York City, N. Y.	360
WHX	Iowa Radio Corporation, Des Moines, Iowa	360
WIK	K. & L. Electric Co., McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros., Philadelphia, Pa.	509
WIZ	Cino Radio Mfg. Co., Cincinnati, Ohio	360
WJD	Richard Harris Howe, Granville, Ohio	229
WJH	White & Boyer Co., Washington, D. C.	273
WJK	Service Radio Equipment Co., Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp. of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America—Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKY	Oklahoma Radio Shop, Oklahoma City, Okla.	360
WLB	University of Minnesota, Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co., Indianapolis, Ind.	360
WLW	Crosley Manufacturing Co., Cincinnati, Ohio	309
WMA	Arlow Radio Laboratories, Anderson, Ind.	360
WMC	Commercial, Memphis, Tenn.	500
WMH	Precision Equipment Co., Cincinnati, Ohio	248
WMH	Doubleday-Hill Elec. Co., Pittsburgh, Pa.	261
WNJ	Shotten Radio Mfg. Co., Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic, Davenport, Iowa	484
WOI	Iowa State College, Ames, Iowa	360
WOK	Arkansas Light & Power Co., Pine Bluff, Iowa	360
WOO	John Wanamaker, Philadelphia, Pa.	509
WOQ	Western Radio Co., Kansas City, Mo.	360
WOR	L. Bamberger Co., Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record, Fort Worth, Tex.	360
WPG	Nashawg Poultry Farm, New Lebanon, Ohio	234
WPI	Electric Supply Co., Clearfield, Pa.	360
WQX	Walter A. Kushl, Chicago, Ill.	360
WRC	Radio Corporation of America, Washington, D. C.	469
WRK	Doron Brothers Electric Co., Hamilton, Ohio	360
WRL	Union College, Schenectady, N. Y.	360
WRM	University of Illinois, Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal, Atlanta, Ga.	429
WSL	J. & M. Electric Co., Utica, N. Y.	273
WSY	Alabama Power Co., Birmingham, Ala.	360
WSZ	Marshall-Gerken Co., Toledo, Ohio	360
WTG	Kansas State Agr. College, Manhattan, Kans.	360
WTP	George M. McBride, Bay City, Mich.	360
WWI	Ford Motor Co., Dearborn, Mich.	273
WWJ	The Detroit News, Detroit, Mich.	517
WWL	Loyola University, New Orleans, La.	280
WAAB	Valdemar Jensen, New Orleans, La.	268
WAAC	Tulane University, New Orleans, La.	360
WAAD	Ohio Mechanics Institute, Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal, Chicago, Ill.	286
WAAK	Gimbel Bros., Milwaukee, Wisc.	280
WAAM	L. R. Nelson Co., Newark, N. J.	263
WAAN	University of Missouri, Columbia, Mo.	264
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co., Decatur, Ga.	360
WAAW	Omaha Grain Exchange, Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co., Emporia, Kans.	360
WABA	Lake Forest College, Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence, Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co., Anderson, Ind.	229
WABD	Parker High School, Dayton, Ohio	286
WABE	Y. M. C. A., Washington, D. C.	283
WABF	Mt. Vernon Register-News Co., Mt. Vernon, Ill.	234
WABG	Arnold Edwards Piano Co., Jacksonville, Fla.	248
WABH	Lake Shore Tire Co., Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co., Bangor, Me.	240
WABJ	Radio Laboratories, South Bend, Ind.	240
WABK	First Baptist Church, Worcester, Mass.	252
WABL	Connecticut Agri. College, Storrs, Conn.	283
WABM	F. E. Doherty, Saginaw, Mich.	254
WABN	Waldo C. Grover, La Crosse, Wisc.	234
WABO	Lake Avenue Baptist Church, Rochester, N. Y.	252
WABP	Robert F. Weinhig, Dover, Ohio	266
WABQ	Haverford College Radio Club, Haverford, Pa.	261
WABR	Scott High School, Toledo, Ohio	270
WABS	Essex Mfg. Co., Newark, N. J.	244
WABT	Holliday-Hall, Washington, Pa.	252
WABU	Victor Talking Machine Co., Camden, N. J.	226
WABV	John H. De Witt, Jr., Nashville, Tenn.	263
WAJV	Indian Pipe Line Corp., Princeton, Ind.	360
WBAA	Purdue University, West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co., Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation, Paterson, N. J.	244
WBAO	James Millikin University, Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co., Columbus, Ohio	390
WBAW	Marietta College, Marietta, Ohio	246
WBAX	John H. Stenger, Jr., Wilkes-Barre, Pa.	360
WBAY	Western Electric Co., New York, N. Y.	492
WBBA	Newark Radio Laboratory, Newark, Ohio	240
WBBD	Barbey Battery Service, Reading, Pa.	224
WCAD	St. Lawrence University, Canton, N. Y.	280
WCAE	Kaufman & Baer Co., Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall, New Orleans, La.	268
WCAH	Entrekin Electric Co., Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel, Houston, Tex.	360
WCAL	St. Olaf College, Northfield, Minn.	360
WCAM	Villanova College, Villanova, Pa.	360
WCAO	Sanders & Stayman Co., Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co., San Antonio, Tex.	360

WCAS Dunworthy Industrial Institute, Minneapolis, Minn. 246
WCAT South Dakota School of Mines..Rapid City, S. D. 240
WCAU Durham & Co. .....Philadelphia, Pa. 286
WCAV J. C. Dice Electric Co.....Little Rock, Ark. 360
WCAX University of Vermont.....Burlington, Vt. 360
WCAY Kesselman O'Driscoll Music House, Milwaukee, Wisc. 261
WCAZ Carthage College.....Carthage, Ill. 246
WCBA Charles W. Haimbach.....Allentown, Pa. 280
WCBD Zion Radio Broadcasting Station.....Zion, Ill. 345
WDAE Tampa Daily Times.....Tampa, Fla. 360
WDAF Kansas City Star.....Kansas City, Mo. 411
WDAG Martin J. Laurence.....Amarillo, Tex. 263
WDAH Trinity Methodist Church.....El Paso, Texas 268
WDAK Hartford Courant.....Hartford, Conn. 261
WDAL Florida Times Union.....Jacksonville, Fla. 360
WDAM Weston Electric Co.....New York, N. Y. 360
WDAO Automotive Electric Co.....Dallas, Tex. 360
WDAP The Board of Trade.....Chicago, Ill. 360
WDAR Lit Brothers .....Philadelphia, Pa. 395
WDAS Samuel W. Waite.....Worcester, Mass. 360
WDAU Slocum & Kilburn.....New Bedford, Mass. 360
WDAX First National Bank.....Centerville, Iowa 268
WDAY Fargo Radio Service Co.....Fargo, N. D. 244
WDBC Kirk Johnson & Co., Inc.....Lancaster, Pa. 258
WEAA Fallain & Lathrop.....Flint, Mich. 280
WEAE Virginia Polytechnic Institute..Blacksburg, Va. 360
WEAF American Tel. & Tel.....New York, N. Y. 492
WEAH Wichita Board of Trade.....Wichita, Kans. 244
WEAI Cornell University.....Ithaca, N. Y. 286
WEAJ University of South Dakota....Vermillion, S. D. 283
WEAM North Plainfield, Borough of Plainfield, North Plainfield, N. J. 252
WEAN Shepard Co.....Providence, R. I. 273
WEAO Ohio State University.....Columbus, Ohio 360
WEAP Mobile Radio Co., Inc.....Mobile, Ala. 360
WEAR Baltimore Am. & News Pub. Co., Baltimore, Md. 360
WEAS Hecht Company.....Washington, D. C. 360
WEAU Davidson Brothers Co.....Sioux City, Iowa 360
WEAY Will Horwitz, Jr.....Houston, Tex. 360
WEAZ Donald Redmond.....Waterloo, Iowa 360
WFAA A. H. Belo & Co.....Dallas, Tex. 476
WFAB Carl C. Woese.....Syracuse, N. Y. 234
WFAF Henry C. Spratley.....Poughkeepsie, N. Y. 273
WFAG Radio Engineering Laboratory, Waterford, N. Y. 360
WFAH Electric Supply Co.....Port Arthur, Tex. 236
WFAJ Hi-Grade Wireless Instrument Co., Asheville, N. C. 360
WFAM Times Publishing Co.....St. Cloud, Minn. 360
WFAN Hutchinson Elec. Service Co..Hutchinson, Minn. 360
WFAQ Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo. 360
WFAT Daily Argus Leader.....Sioux Falls, S. D. 360
WFAV University of Nebraska.....Lincoln, Nebr. 275
WGAC Orpheum Radio Stores Co.....Brooklyn, N. Y. 360
WGAD Spanish Am. Sch. of Telegraphy, Enconada, P. R. 360
WGAJ W. H. Glass.....Shenandoah, Iowa 360
WGAL Lancaster Elec. Supply & Const. Co., Lancaster, Pa. 248
WGAN Cecil E. Lloyd.....Pensacola, Fla. 360
WGAQ W. G. Patterson.....Shreveport, La. 360
WGAW Ernest C. Albright.....Altoona, Pa. 261
WGAX Radio Electric Co., Washington Courthouse, Ohio 360
WGAY North Western Radio Co.....Madison, Wisc. 360
WGAZ South Bend Tribune.....South Bend, Ind. 360
WHAA State University of Iowa.....Iowa City, Iowa 283
WHAB Clark W. Thompson.....Galveston, Tex. 360
WHAC Cole Brothers Elec. Co.....Waterloo, Iowa 360
WHAD Marquette University.....Milwaukee, Wisc. 360
WHAG University of Cincinnati.....Cincinnati, Ohio 222
WHAH J. T. Griffin.....Joplin, Mo. 360
WHAK Roberts Hardware Co.....Clarksburg, West Va. 258
WHAM Eastman School of Music of Univ. of Rochester, Rochester, N. Y. 283
WHAP Dewey L. Otta.....Decatur, Ill. 360
WHAR Paramount Radio and Elec Co., Atlantic City, N. J. 231
WHAS Courier Journal & Times.....Louisville, Ky. 400
WHAV Wilmington Elec. & Supply Co., Wilmington, Del. 360
WHAX Huntington Press.....Huntington, Ind. 360
WHAZ Rensselaer Polytechnic Institute.....Troy, N. Y. 380
WIAB Joslyn Automobile Co.....Rochford, Ill. 360
WIAD Howard R. Miller .....Philadelphia, Pa. 254
WIAF Gustav A. De Cortin.....New Orleans, La. 234
WIAH Continental Radio and Mfg. Co., Inc., Newton, Iowa 258
WIAI Heers Stores Co.....Springfield, Mo. 252
WIAK Journal Stockman Co.....Omaha, Nebr. 278
WIAP J. A. Rudy & Sons.....Paducah, Ky. 360
WIAQ Chronicle Publishing Co.....Marion, Ind. 226
WIAS Burlington Hawkeye-Home Elec. Co., Burlington, Ia. 360
WIAT Leon T. Noel.....Tarkio, Mo. 360
WIAU American Sec. & Sav. Bank.....Le Mars, Ia. 360
WIAV New York Radio Laboratories, Binghamton, N. Y. 360
WIAW Saginaw Radio & Elec. Co.....Saginaw, Mich. 360
WIAD Jackson's Radio Eng. Lab.....Waco, Tex. 360
WIAF Press Pub. Co.....Muncie, Ind. 360
WIAG Huse Publishing Co.....Norfolk, Nebr. 360
WIAJ Y. M. C. A.....Dayton, Ohio 360
WIAK Rev. C. L. White.....Greentown, Ind. 254
WIAM D. C. Perham.....Cedar Rapids, Iowa 268
WIAN Peoria Star Co.....Peoria, Ill. 360
WIAR The Outlet Co.....Providence, R. I. 360
WIAS Capper Publications.....Topeka, Kans. 360
WIAT Kelly-Vawter Jewelry Co.....Marshall, Mo. 360
WIAX Union Trust Co.....Cleveland, Ohio 390
WIAZ Chicago Radio Laboratory.....Chicago, Ill. 448
WKAA H. F. Paar.....Cedar Rapids, Iowa 268
WKAD Charles Looff.....East Providence, R. I. 240
WKAF W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex. 360
WKAN Alabama Radio Mfg. Co.....Montgomery, Ala. 360
WKAP Dutee Wilcox Flint.....Cranston, R. I. 360
WKAQ Radio Corporation of Porto Rico, San Juan, P. R. 360
WKAR Michigan Agri. College...East Lansing, Mich. 280
WKAS L. E. Lines Music Co.....Springfield, Mo. 360
WKAV Laconia Radio Club.....Laconia, N. H. 254
WKAW United Battery Service Co., Montgomery, Ala. 226
WKAY Brenau College.....Gainesville, Ga. 280
WLAG Cutting & Washington Radio Corp., Minneapolis, Minn. 417
WLAH Samuel Woodworth.....Syracuse, N. Y. 234
WLAJ Waco Electrical Supply Co.....Waco, Tex. 360
WLAK Vermont Farm Mach. Co....Bellows Falls, Vt. 360
WLAL Tulsa Radio Co.....Tulsa, Okla. 360
WLAN Putnam Hardware Co.....Houlton, Me. 283
WLAP W. V. Jordon.....Louisville, Ky. 360
WLAQ Arthur S. Schilling .....Kalamazoo, Mich. 360
WOAR Henry P. Lundskow .....Kenosha, Wisc. 229
WLAS Central Radio Supply Co.....Hutchinson, Kans. 244
WLAT Radio and Specialty Co.....Burlington, Iowa 360
WLAV Electric Shop, Inc.....Pensacola, Fla. 254
WLAW New York Police Dept.....New York, N. Y. 360
WLAX Greencastle Community Broadcasting Station, Greencastle, Ind. 231
WMAB Radio Supply Co.....Oklahoma City, Okla. 360
WMAC J. Edward Page.....Cazenovia, N. Y. 261
WMAF Round Hills Radio Corp.....Dartmouth, Mass. 360
WMAH General Supply Co.....Lincoln, Nebr. 254
WMAJ Drovers Telegram Co.....Kansas City, Mo. 275
WMAK Norton Laboratories.....Lockport, N. Y. 360
WMAL Trenton Hdw. Co.....Trenton, N. J. 250
WMAN First Baptist Church.....Columbus, Ohio 286
WMAP Utility Battery Service, Inc.....Easton, Ohio 246
WMAQ Chicago Daily News .....Chicago, Ill. 448
WMAV Alabama Polytechnic Institute....Auburn, Ala. 250
WMAW Wahpeton Elec. Co.....Wahpeton, N. D. 360
WMAY Kingshighway Presby. Church....St. Louis, Mo. 280
WMAZ Mercer University .....Macon, Ga. 268
WNAB Park City Daily News.....Bowling Green, Ky. 360
WNAC Shepard Stores .....Boston, Mass. 278
WNAD Oklahoma Radio Eng. Co.....Norman, Okla. 360
WNAL R. J. Rockwell .....Omaha, Nebr. 242
WNAM Ideal Apparatus Co. .....Evansville, Ind. 360
WNAN Syracuse Radio Telephone Co..Syracuse, N. Y. 286
WNAP Wittenberg College .....Springfield, Ohio 360
WNAQ Charleston Radio Elec. Co.....Charleston, S. C. 360
WNAR Rhodes, C. C. .....Butler, Mo. 231
WNAS Texas Radio Corporation and Austin Statesman, Austin, Tex. 360
WNAT Lenning Bros. Co. .....Philadelphia, Pa. 360
WNAV Peoples Tel. & Tel. Co.....Knoxville, Tenn. 236
WNAW Henry Kunzmann .....Fortress Monroe, Va. 360
WNAX Dakota Radio Apparatus Co.....Yankton, S. D. 244
WNAY Ship Owners' Radio Service.....Baltimore, Md. 360
WOAA Dr. Walter Hardy .....Ardmore, Okla. 360
WOAC Maus Radio Co. .....Lima, Ohio 266
WOAD Friday Battery & Elec. Co.....Sigourney, Iowa 360
WOAE Midland College .....Fremont, Nebr. 360
WOAF Tyler Commercial College.....Tyler, Tex. 360
WOAG Apollo Theatre .....Belvidere, Ill. 224
WOAH Palmetto Radio Corp.....Charleston, S. C. 360
WOAI Southern Equipment Co.....San Antonio, Texas 385
WOAJ Ervin's Electrical Co. .....Parsons, Kans. 360
WOAL Wm. Evans Woods .....Webster Groves, Mo. 286
WOAN James D. Vaughan .....Lawrenceburg, Tenn. 360
WOAP Kalamazoo College .....Kalamazoo, Mich. 360
WOAT Boyd Martell Hamp .....Wilmington, Del. 360
WOAV Pennsylvania National Guard.....Erie, Pa. 242
WOAW Woodmen of the World.....Omaha, Nebr. 526
WOAX Franklyn J. Wolff .....Trenton, N. J. 240
WPAB Pennsylvania State College..State College, Pa. 283
WPAC Donaldson Radio Co. .....Okmulgee, Okla. 360
WPAD Wiebodt & Co. .....Chicago, Ill. 360
WPAG Central Radio Co., Inc.....Independence, Mo. 360
WPAH Wisconsin Dept. of Markets.....Waupaca, Wisc. 360
WPAJ Doolittle Radio Corporation...New Haven, Conn. 268
WPAK No. Dakota Agricultural College...Fargo, N. D. 360
WPAL Superior Radio & Telephone Co., Columbus, Ohio 286
WPAM Awerbach & Guettel .....Topeka, Kans. 360
WPAP Theodore D. Phillips .....Winchester, Ky. 360
WPAQ General Sales & Eng. Co.....Frostburg, Md. 360
WPAR R. A. Ward .....Beloit, Kans. 360
WPAS J. & M. Electric Co.....Amsterdam, N. Y. 360
WPAT St. Patrick's Cathedral .....El Paso, Tex. 360
WPAU Concordia College .....Moorhead, Minn. 360
WPAY Bangor Radio Laboratory .....Bangor, Me. 360
WPAZ John R. Koch .....Charleston, West Va. 273
WQAA Horace A. Beale, Jr.....Parkersburg, W. Va. 360
WQAC E. B. Gish .....Amarillo, Tex. 360
WQAD Whitehall Electric Co. .....Waterbury, Conn. 242
WQAE Moore Radio News Station.....Springfield, Vt. 275
WQAF Sandusky Register .....Sandusky, Ohio 240
WQAH Brock Anderson Elec. Eng. Co., Lexington, Ky. 254
WQAK Appel-Higley Electric Co.....Dubuque, Iowa 360
WQAL Coie County Tel. & Tel. Co.....Mattoon, Ill. 258
WQAM Electrical Equipment Co. .....Miami, Fla. 360
WQAN Scranton Times .....Scranton, Pa. 360
WQAO Calvary Baptist Church.....New York, N. Y. 360
WQAQ West Texas Radio Co.....Abilene, Tex. 360
WQAS Prince Waiter Co. .....Lowell, Mass. 266
WQAT Radio Equipment Corporation.....Richmond, Va. 360
WQAV Huntington and Guerry, Inc....Greenville, S. C. 258
WQAW Catholic University of America, Washington, D. C. 236
WQAX Radio Equipment Co. .....Peoria, Ill. 360
WRAA Rice Institute .....Houston, Tex. 360
WRAD Taylor Radio Shop .....Marion, Kans. 248
WRAF Radio Club, Inc. .....Laporte, Ind. 224
WRAH Stanley N. Reed .....Providence, R. I. 231
WRAL Northern States Power Co..St. Croix Falls, Wisc. 248
WRAM Lombard College .....Galesburg, Ill. 244
WRAN Black-Hawk Electric Co.....Waterloo, Iowa 236
WRAO Radio Service Co. .....St. Louis, Mo. 360
WRAV Antioch College .....Yellow Springs, Ohio 360
WRAW Horace D. Good .....Reading, Pa. 238
WRAX Flexon's Garage .....Gloucester City, N. J. 268
WRAY Radio Sales Corporation.....Scranton, Pa. 280
WRAZ Rensselaer Polytechnic Institute....Troy, N. Y. 380
WSAA B. S. Sprague Elec. Co.....Marietta, Ohio 360
WSAB Southeast Mo. State College, Cape Girardeau, Mo. 360
WSAC Clemson Agri. College....Clemson College, S. C. 360
WSAD J. A. Foster Co. .....Providence, R. I. 261
WSAH A. G. Leonard, Jr.....Chicago, Ill. 248
WSAI U. S. Playing Card Co.....Cincinnati, Ohio 309
WSAJ Grove City College .....Grove City, Pa. 360
WSAL Franklin Electrical Co.....Brookville, Ind. 246
WSAN Allentown Radio Club .....Allentown, Pa. 229
WSAP Seventh Day Adventist Church..New York, N. Y. 263
WSAR Doughty & Welch Elec. Co....Fall River, Mass. 254
WSAT Plainview Elec. Co. .....Plainview, Tex. 268
WSAW Curtice & McElwee .....Canandaigua, N. Y. 275
WSAX Chicago Radio Laboratory.....Chicago, Ill. 268
WSAY Irving Austin, Chamber of Commerce, Port Chester, N. Y. 233
WSAZ Chase Electric Shop .....Pomeroy, Ohio 258
WTAB Fall River Daily Herald.....Fall River, Mass. 248
WTAC Penn Traffic Co. .....Johnstown, Pa. 360
WTAD Robert E. Compton .....Carthage, Ill. 229
WTAG Kern Music Co. .....Providence, R. I. 258
WTAH Carmen Ferro .....Belvidere, Ill. 236
WTAJ The Radio Shop .....Portland, Me. 236
WTAL Toledo Radio and Electrical Co, Toledo, Ohio 252
WTAM Willard Storage Battery Co....Cleveland, Ohio 390
WTAN Orndorff Radio Shop .....Mattoon, Ill. 240
WTAP Cambridge Radio & Electric Co..Cambridge, Ill. 390
WTAQ S. H. Van Gorden & Son.....Osselo, Wisc. 226
WTAR Reliance Electric Co. .....Norfolk, Va. 226
WTAS Charles E. Erbstein.....Elgin, Ill. 275
WTAT Edison Elect. Ill. Co.....Boston, Mass. 244
WTAU Ruegy Battery & Elec. Co.....Tecumseh, Nebr. 360
WTAW Agricultural and Mech. College, College Station, Tex. 254
WTAX Williams Hardware Co.....Streator, Ill. 231
WTAY Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill. 226
WTAZ Thomas J. McGuire .....Lambertville, N. J. 283
WWAB Swern Hoenig & Co.....Trenton, N. J. 226
WWAC Sanger Brothers .....Waco, Tex. 360
WWAD Wright & Wright, Inc.....Philadelphia, Pa. 360
WWAE Alamo Dance Hall .....Joliet, Ill. 227
WWAF Galvin Radio Supply Co. .....Camden, N. J. 236
WWAH General Supply Co. .....Lincoln, Nebr. 360
WWAO Michigan College of Mines....Houghton, Mich. 244

Canadian Broadcasting Stations

CKY Manitoba Telephone System.....Winnipeg, Manitoba
CFAC Radio Corporation of Calgary, Ltd...Calgary, Alberta
CFCA Star Publishing and Printing Co., Toronto, Ontario
CFCB Marconi Wire.ess Telegraph of Canada, Ltd., Vancouver, B. C.
CFCD Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba
CFCE Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia
CFCF Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec
CFCH Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario
CFCI Motor Products Corporation.....Walkerville, Ontario
CFCN W. W. Grant Radio, Ltd.....Calgary, Alberta
CFCX The London Advertiser.....London, Ontario
CFPC International Radio Development Co., Fort Frances, Ontario
CFTC The Bell Telephone Co. of Canada....Toronto, Ontario
CFUC University of Montreal.....Montreal, Quebec
CFVC Roy Russell Brown.....Courtenay, British Columbia
CFYC Victor Wentworth Odium.....Vancouver, B. C.
CFZC Canadian Westinghouse Co., Ltd.....Montreal, Quebec
CHAC Radio Engineers, Ltd.....Halifax, Nova Scotia
CHBC The Albertan Publishing Co.....Calgary, Alberta
CHCA Radio Corporation of Vancouver, Ltd., Vancouver, B. C.
CHCB Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario
CHCC Canadian Westinghouse Co., Ltd., Edmonton, Alberta
CHCF Radio Corporation of Winnipeg, Ltd., Winnipeg, Manitoba
CHCQ The Western Radio Co., Ltd.....Calgary, Alberta
CHCS London Radio Shoppe .....London, Ontario
CHCX B. L. Silver .....Montreal, Quebec
CHCZ The Globe Printing Co. .....Toronto, Ontario
CHFC John Millen & Sons, Ltd.....Toronto, Ontario
CHIC Canadian Westinghouse Co., Ltd....Hamilton, Ontario
CHOC Canadian Westinghouse Co., Ltd.....Vancouver, B. C.
CHVC Metropolitan Motors, Ltd.....Toronto, Ontario
CHXC J. R. Booth, Jr. .....Ottawa, Quebec
CHYC Northern Electric Co. .....Montreal, Quebec
CJBC Dupuis Freres .....Montreal, Quebec
CJCA The Edmonton Journal, Ltd.....Edmonton, Alberta
CJCB James Gordon Bennett.....Nelson, British Columbia
CJCD T. Eaton Co., Ltd.....Toronto, Ontario
CJCE Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.
CJCF News Record, Ltd. .....Kitchener, Ontario
CJCG Manitoba Free Press Co., Ltd....Winnipeg, Manitoba
CJCH The United Farmers of Ontario.....Toronto, Ontario
CJCI McLean, Holt & Co., Ltd....St. John, New Brunswick
CJCN Simons Agnew & Co.....Toronto, Ontario
CJCS Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia
CJCY Edmund Taylor .....Calgary, Alberta
CJGC London Free Press Printing Co., Ltd., London, Ontario
CJNC Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba
CJSC The Evening Telegram .....Toronto Ontario
CKAC La Presse Publishing Co.....Montreal, Quebec
CKCB T. Eaton Co., Ltd.....Winnipeg, Manitoba
CKCD Vancouver Daily Province.....Vancouver, B. C.
CKCE Canadian Independent Telephone Co., Ltd., Toronto, Ontario
CKCK Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan
CKCR Jones Electric Radio Co.....St. John, New Brunswick
CKCS The Bell Telephone Co. of Canada...Montreal, Quebec
CKCZ Canadian Westinghouse Co., Ltd.....Toronto, Ontario
CKKC Radio Equipment and Supply Co....Toronto, Ontario
CKOC The Wentworth Radio Supply Co....Hamilton, Ontario
CKQC Radio Supply Co. of London.....London, Ontario
CKZC Salton Radio Engineering Co.....Winnipeg, Manitoba

Afloat and Ashore With the Operator

As Reported by W. S. Fitzpatrick

HEY! AL BRING THE CAMERA
HOW DO THEY GET LIKE THAT?
HE OUGHT TO HAVE HIS CALL LETTERS "CQ" AND "ORU" IN GOLD ON HIS COLLAR
PITY HE CAN'T CARRY THE SET AROUND AND SHOW IT TO THE GIRLS
ISN'T HE GRAND?
STENO
INDOOR RADIO SPORTS - RAZZING THE GUY WHO WEARS HIS UNIFORM ASHORE

THE radio section of the New York Police Department has received many well deserved press notices of its activities and attained results, but it appears that commercial radio operators as a whole, much less the general public, are not as well informed as they should be regarding the service rendered and the achievement of KUVS and its subsidiary stations on the police boats about the harbor.

The section was organized in 1917 by Sergeant Charles E. Pearce and a short time later was placed under Inspector M. R. Brennan, Superintendent of Telegraph of the Police Department. With Sergeant Pearce as the practical radio head and as Inspector Brennan's chief adviser, the organization was developed into a high state of efficiency. Two years ago Sergeant Pearce retired from the Police Department to enter the service of the Radio Corporation of America, in which he is now an executive.

There is an efficient corps of operators, all with first class government licenses and all members of the Police Department, who alternate duty between the headquarters station and the police boats. These boats frequently go out into the open sea, so the men might well be termed seagoing operators.

Sergeant Charles E. Pearce, who built and operated the first successful Police Radio Station in the world

In addition to the assistant operators, the repair and apparatus men, the personnel of New York's police radio experts consists of John F. Ward, Charles E. Gaul, Charles E. Francis, Russell McKee, George Wolfe and Louis J. Michaels. During several years before joining the Police Department, Mr. Michaels was an operator on passenger ships and is well known among commercial radio men.

Quite a number of communications pass between big passenger liners and the headquarters station and boats and there have been occasions when cargo ships were well served by the alertness of the police operators.

* * *

An example of the opportunity for travel afforded radio men can be cited by Paul S. Barnard, who lives in San Francisco and who was running on ships out of that port. He wanted to see England. When he told the chief operator at San Francisco of his desires that very accommodating gentleman, having no ships running direct to England to place him on, gave him an assignment to the Isthmian liner *Steelage,* bound for New York, then passed the word by mail to the chief operator at New York, requesting that Barnard's wish be respected, if possible. Upon the operator's arrival in New York, he was without loss of time transferred to the *Eastern Tempest,* on which he was enabled to spend a pleasant fortnight in England. Returning to New York he was transferred to the *Sutermco,* which brought him back to San Francisco, ending a quick, pleasant and profitable journey and fulfilling his wish.

* * *

A well known radio operator told this as an original story the other day. An old lady making her first sea voyage noticed the radio operators lounging easily and having a general pleasant time, while the captain and chief mate were forever hurrying about the ship, looking at this and that and always busy. Evidently she had made a comparison between the two lines of endeavor and when the opportunity afforded hailed the captain and inquired very sweetly:

"Oh, captain, how long do you have to serve in your present position before you become a radio operator?"

* * *

A comparison is often made between the present day marine radio working with that of a few years ago before the vacuum tubes came into use. The radio fan of today imagines that long distance receiving was unheard of and that broadcasting is not more than three years old.

Mr. C. D. Guthrie, now radio supervisor of the New York district office of the Shipping Board, used to listen to music being broadcast from a naval ship during the Jamestown Exposition in 1907. The writer heard an opera broadcast in 1910. Ships running to South America used to maintain direct communication with New York up to two and three thousand miles around 1909. San Francisco, with a five kilowatt transmitter and crystal detector, exchanged weather reports and names with Japan, a distance of 5,800 miles, in 1910.

Charles A. Hahne, now traffic manager of a radio company, was instrumental in saving the life of William Jennings Bryan and other passengers on a ship over two thousand miles away from New York, where he was a coast station operator, in 1911.

RADIO NEWS FROM ALL OVER THE WORLD

Government's Preparation for Mexico City Conference

WORK on the agenda of the United States for the forthcoming Inter-American Electrical Communications Commission, scheduled for January or February in Mexico City, is progressing rapidly. The Inter-Departmental Committee on Electrical Communications under the direction of Leland Harrison, Assistant Secretary of State, has organized a special sub-committee which is attacking the practical and operating problems having to do with international radio communications.

Judge S. B. Davis, Solicitor of the Department of Commerce, and representative of that department on the Communication Committee, has been designated as head of the radio sub-committee and has appointed two sections, one on technical problems and another on mobile radio questions.

Dr. J. H. Dellinger, of the Bureau of Standards, is chairman of the section on technical radio problems. This section is considering such problems as frequency, or wave length, allocation, means of preventing radio interference, and standards of technical operation, as well as the gathering of technical data relative to radio transmitting stations.

The section studying questions affecting mobile radio operation is headed by Commander D. C. Bingham, Asst. Director of Naval Communications. Questions affecting international rules regarding the operation of radio on board ships, aircraft, etc., will be studied by this committee. Among the subjects to be covered are: distress calls and matters pertaining to safety of life at sea, time signals, hydrographic and meteorological information of international interest.

Advice and suggestions from representatives of commercial companies will be sought on the matters under consideration, including standardization of practice and operation, in which agreements with other American Republics are desired.

Upon the completion of the two surveys by the United States Government Radio Committee, a comprehensive report to the full communication committee will be made, and in event of approval, it will form the basis of the "U. S." agenda to be carried to the Pan-American conference early in 1924 in Mexico. Later on, the agreements arrived at there may be presented to the World Conference on Electrical Communications in Paris, by accredited representatives of the New World.

Los Angeles to Hold Show

THE Second Annual Western Radio and Electrical Exposition will be held at the Biltmore Hotel from February 5 to 10. J. C. Johnson, of New York radio fame, will manage the show.

Progress of Radio on the Farm

AGENTS of the Department of Agriculture have estimated after a careful survey that there is a total of more than 145,000 radio sets on farms throughout the country. In New York it is estimated that there are 5,502 sets on farms. Two thousand five hundred sets are reported from the farms of Saratoga County alone. There are about 3,085 sets on Texas farms. Farms in other states are reported as follows: In Illinois, 2,814; in Ohio, 2,620; in Missouri, 2,861; in Iowa, 2,463, and in Kansas, 2,054. New Jersey, Pennsylvania, Michigan and Minnesota have between 1,000 and 2,000 sets each.

Owen D. Young for Reparation Commission

THE selection of Owen D. Young, Chairman of the Board of Directors of the Radio Corporation of America to be one of the two American experts serving on the committee which will investigate Germany's ability to pay is one that illustrates President Coolidge's shrewd evaluation of men and one that wins the hearty commendation of business men and men of affairs to whom Mr. Young's outstanding qualifications and accomplishments are well known.

Army Radio at Panama Canal Post

A detachment of the 10th Signal Company with radio tractor on the beach of Belle Vista, Republic of Panama

International Development of Radio Week

NATIONAL RADIO WEEK, November 25th to December 1st, was a week of memorable events.

In order to live up to the splendid co-operation from the press of the country to make that event the biggest, recent celebration on the air, programs were arranged to present the breadth of possibilities in home radio entertainment and to promote the social spirit that is possible by means of this universal as well as informal mode of communication.

Among the notable achievements of the week was the trans-oceanic broadcast station tests, organized and conducted by Radio Broadcast, the British Broadcasting Company and the Wireless World and Radio Review (London).

Of the most prominent speakers in this country were Owen D. Young, Chairman of the Boards of Directors of the General Electric Company and the Radio Corporation of America, General James G. Harbord, President of the Radio Corporation, Henry Ford and Charles Evans Hughes.

Co-operation of amateurs, ship and shore operators, broadcasters and radio executives undoubtedly made the tests a success. Because of the difference in time between England and America extreme care was necessary to assure "open air" and as well a convenient period when darkness prevailed simultaneously in both countries.

The British stations were received as far north as Nova Scotia, as far south as Texas and as far west as Davenport, Iowa, and scattered points in North Dakota. Altogether, 18 states in this country and two provinces in Canada are represented in the reports of successful reception.

In England the reception of American broadcast stations was generally more successful than the British stations heard on this side because our stations used more power for transmitting.

General James G. Harbord's address, an incident of National Radio Week and the concluding speech of the international broadcast tests, contained America's message to the British broadcast listeners.

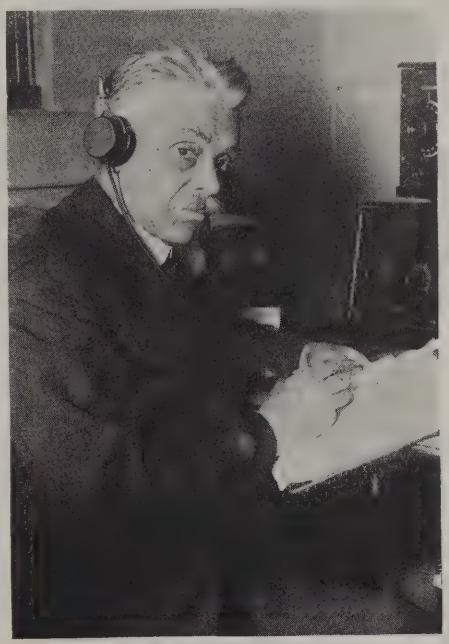
General Harbord opened his address with a comment on the marvel of talking to people of the Old and New Worlds without having to raise his voice above conversational tones.

Continuing, he said, "Leaders of political thought, culture, science and the arts are enabled to address millions of their countrymen in all walks of life, in city and country, with an ease rivaling the intimacy of the telephone.

"From those across the sea — our kinsmen by blood and tongue—have come your own statesmen in recent months, and served by this same genii, Radio, their voices have reached millions of our people.

"And now, scarcely before we have been able to grasp and assimilate the tremendous import of it all, we are invited to speak to our British cousins across the weary stretches of three thousand miles of the intervening Atlantic.

". . . As my voice reaches the people of England tonight, my memory pictures the great service and unfailing hospitality that our American soldiers



HIRAM PERCY MAXIM

President of the American Radio Relay League, caught England's "Hello, America"

received at your hands, while on their way to France . . .

"Our nations are closely cemented by the unity of a democratic purpose, by the same high ideals and by a common language. Let us hope that this first change of thought by voice across the broad Atlantic will serve to strengthen our existing friendship in permanent bonds of understanding.

"The programs of this National Radio Week have constituted the first attempt to reach you through organized broadcasting, and to receive your acknowledgments through your own broadcasting stations. Surely radio is the harbinger of a closer tie and more thorough understanding among the nations of the earth."

International broadcasting is now no longer an idle dream, but a fact.

MacMillan Arctic Expedition

THROUGH the station of Jack Barnsley, amateur operator, at Prince Rupert, B. C., messages have been received from the *Bowdoin*, icebound for the long Arctic winter, which inform that this adventurous party are keeping in the best of spirits very largely through the agency of radio. They report that they are hearing stations in England, Germany, Holland, Mexico, France, Norway, Italy, Japan and Spain, that they are getting each evening the news of the world from stations in Oxford, England and Nauen, Germany, and that the operator on the MacMillan ship has actually talked with 6CEU in Hawaii, over a distance of 5,000 miles.

Germans Radio to Moving Trains

GERMANY recently had a demonstration of wireless telephonic communication between a moving train and ordinary receiving and transmitting stations, according to U. S. Consul Richardson, at Berlin. Messages were exchanged between the President and officials of the government in Berlin and other officials on a train, moving at 30 miles an hour, half way between Berlin and Hamburg. The "Huth" system, which is a combination of wireless and wire transmission, was used. The sending apparatus was installed in a compartment on the train and the antenna rigged over the tops of two cars. The line telegraph wires along the track are said to have picked up the messages and transmitted them to Berlin, where the line was connected with a receiving set.

Radio Traffic Illustrated

DURING the course of his interesting address at the Boston City Club recently, dealing with the application of radio communication to ships at sea, Mr. David Sarnoff gave a practical demonstration of how effective radio has become in signaling to distant vessels.

For this experiment, the telegraphic controls of the high power marine radio station at Chatham, Mass., were linked by land wires to telegraph instruments on the speaker's platform. Thus Mr. Sarnoff was able by the operation of the instruments before him to reach out to the extremities of the North Atlantic and communicate with all vessels within radio range of the Chatham Station.

Mr. Sarnoff stepped to the sending key on the table before him and by the mere tapping of the key, he literally swept the ocean with radio waves laden with this message:

"Two thousand members and guests of Boston City Club now assembled in Boston intensely interested in special marine radio demonstratiton and would greatly appreciate courtesy of your advising quickly approximate distance from Boston and present weather conditions, thanks,

DAVID SARNOFF,
Vice-President and General Manager, Radio Corp. of America."

Replies to the message were received from vessels almost instantly and as replies were received the position of these vessels on the high seas was indicated on a chart of the world which had been provided on the platform, with the radio station at Chatham plainly indicated.

Radio in French Trains

SOME time ago experiments with radio on moving trains gave little hope of ultimate success, but only recently new attempts have shown the entire feasibility of the idea. After long and patient research new trials were conducted recently on the Bordeaux to Paris train, while it was between Tours and Paris, with encouraging results. The travelers were able to hear with ease and clarity both the concerts from the Radiola station and the news announcements of the Eiffel Tower.

The receiving set used four stages of radio frequency and one of audio, and was contained in a cabinet provided with rubber shock absorbers. Four loud speakers were used, two in each end of the car.

The antenna problem was solved by the use of three wires, each 20 meters (66 feet) long stretched inside the car. This meant that the antenna necessarily was low, but the line of the railroad is generally high and seemed to compensate for the lowness of the antenna. The ground consisted of an insulated wire stretched under the wooden steps that run the entire length of the car. In earlier tests an attempt was made to ground the receiver directly on the trucks of the car, but in the latest test this was not tried, the wire just described giving complete satisfaction.

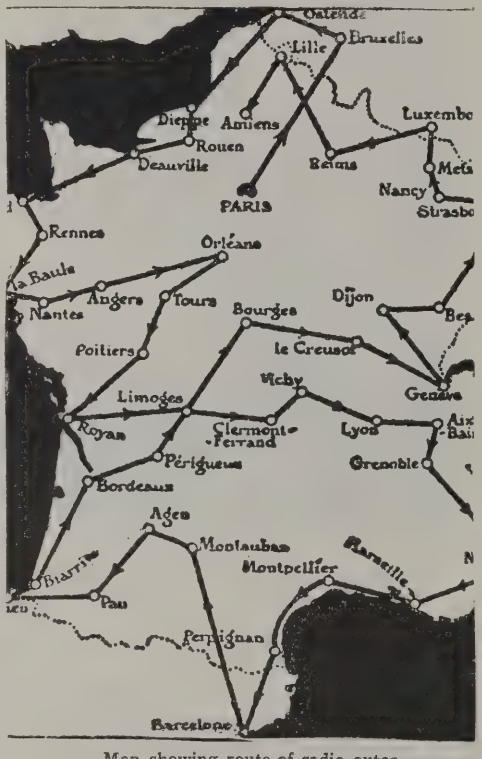
Cuban Broadcasting Stations

CUBA boasts of twenty-seven radiophone broadcasting stations, of which six are rated at 500 watts. Four other stations have an output of 100 watts. The principal stations are PWX, the Cuban Telephone Company; 6KW, Frank H. Jones; 2CX, Frederick W. Borton, and 6DW, Eduardo Terry.

Radio Autos Touring France

THE magazine "Je Sais Tout" (I Know Everything) of Paris has started a radio-equipped automobile caravan on a tour of France. The expedition consists of three automobiles, under the direction of the engineer Guineau of the Ministry of Public Instruction, two of which carry a complete transmitter while the third is equipped with receiving apparatus. At each town at which a stop is made, the transmitter broadcasts a concert of speeches and music, which is reproduced through the loud speakers of the receiving automobile, which also on occasion picks up concerts from Paris.

Each automobile from the exterior seems like any ordinary limousine, but



Map showing route of radio autos

its equipment is anything but ordinary. The transmitter has 250 watts power, and works on 400 meters. An itinerary covering 8,000 kilometers (4,800 miles) in three and a half months has been laid out, taking the expedition not only throughout France, but also touching Belgium, Luxembourg, Switzerland and Spain.

This is the first effort of the kind in Europe, and is expected to add greatly to the popularity of the radio telephone in France and neighboring countries. Collections taken up at each stop will be added to those realized during the celebration at the Trocadero, Paris, several months ago, for the establishment of a foundation for rewarding inventors of important radio improvements.

An Uncanny Coincidence

By J. O. SMITH

RADIO is credited with many strange and weird performances and many are the tales that have been told of strange happenings in radio operation that could not be readily accounted for, but it is doubtful if anything more strange, in fact uncanny, has ever occurred than was true during the time all radio traffic and seacoast broadcasting was stopped on the night of November 29th because of an SOS from the SS. *Henry Farnum*, Call KQA, ashore off the Florida coast.

The *Farnum* first broadcasted an SOS about 9:00 P. M. which was first picked up by two other steamships, the KDCB and the WAX. These ships immediately rebroadcasted the SOS of the *Farnum* and the navy yard stations along the coast immediately ordered complete cessation of all ship-shore traffic. Broadcasting stations along the coast were also ordered to stop transmission.

Through this blanket of practically absolute silence could be heard the spark signals of the WAX as communication was carried on with the *Farnum*. The WAX was evidently not hearing the KQA well and could be heard repeating back parts of a long received message for verification, one section of which was to the effect that the *Farnum* "was aground five miles from —"

A few minutes afterward the voice of the announcer of broadcasting station KSD at St. Louis on 546 meters and close to the wave length of the WAX boomed out of the loud speaker to the effect that "The ship ran aground and was destroyed."

It was only part of the announcement of the next number to be broadcasted, a descriptive one, by a symphony orchestra at the Odeon, St. Louis, but it caused many a gasp of wonder and surprise from those listening to this Thanksgiving night tragedy of the sea. It was just another of the strange happenings which sometimes occur in radio operation and certainly was uncanny although understandable.

Amundsen's Ship Heard From by Radio

EARLY in December, Captain Raold Amundsen's exploration ship, *Maud* established radio communication with Spitzbergen. The ship's position was given as 75.10 latitude north. 159.30 longitude east. This is north of Siberia near the route taken by De Long in 1881. The *Maud* left Seattle in June, 1922, carrying Capt. Amundsen and an exploration party, but Amundsen later left the vessel to make preparations for his airplane flight across the North Pole, which he subsequently postponed until next summer.

Broadcasting in Sweden

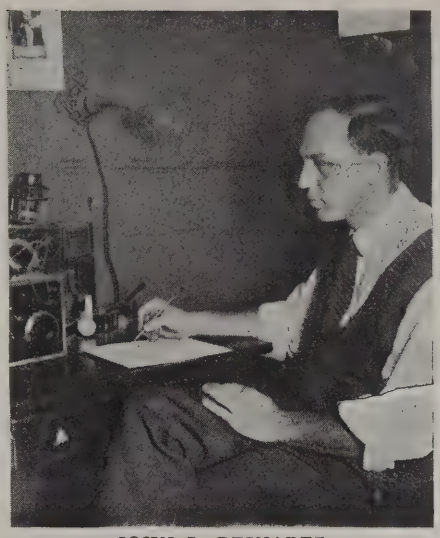
RESPONDING to the request of numerous industrial firms, the Swedish government has just authorized the formation of a broadcasting company, the Rundradiobolaget, the owners of which are representatives of Swedish newspapers and metallurgical firms. Ten broadcasting stations are to be erected, to cover the entire kingdom. The principal stations will be at Stockholm, Göteborg, Malmo and Orebro. Each will have a power of 1 kw. The Swedish government will have full control of the stations, and authorized the program of construction only after investigating the possibilities, and concluding that broadcasting would combat the tendency of the people to flock into the large cities, and also would strengthen the family by making the home more attractive.

Broadcasting in Panama

PERMISSION for broadcasting entertainment programs has been given by the U. S. Navy to the radio stations in the Panama Canal Zone, and that part of tropical America soon will hear its share of radio telephone programs. For the time being it is likely that all such programs will be transmitted by the Navy stations, as the United States is in complete control of all radio work not only in the Canal Zone, but in the Republic of Panama, by agreement with the latter. Leading Panamanians are understood to have appealed for a loosening of the restrictions to permit broadcasting.

Broadcasting in Chile

IN Santiago, Valparaiso, and several smaller Chilean cities, interest in radio telephony is growing steadily and its fuller development only awaits the establishment of a broadcasting station within the country such as those now in operation on the east coast of South America, says Assistant U. S. Trade Commissioner W. E. Embry in a report to the Department of Commerce. It is reported that the broadcasting stations recently erected in Buenos Aires, Montevideo, and Rio de Janeiro have given very satisfactory results and large numbers of amateur receiving sets have been sold in these countries. This is especially true of the Argentine where conditions for broadcasting programs are almost ideal as the land generally is flat and radio transmission carries all over the River Plate district, Uruguay, and into southern Brazil on the north and as far as the Andes on the east. For this reason, the sale of radio equipment has met with the greatest success in the country and it is now estimated that



JOHN L. REINARTZ
Daddy of Reinartz Circuit

there are approximately 25,000 sets in the Argentine Republic, in comparison with approximately 100, less than one year ago.

Denmark Listens In Before Cock-Crow

ENTHUSIASTIC radio amateurs in Denmark are always endeavoring to catch broadcasting from the United States, even though this country lies in a somewhat more unfavorable position to receive American radio messages than other European countries.

Canada Plans Radio Beacon

THE Canadian Government is about to install a powerful direction-finding wireless station at Pachena, on the west coast of Vancouver Island, British Columbia, to protect ships of all nations entering the Straits of Juan de Fuca en route to American and Canadian ports. Numerous shipwrecks have occurred in this district, and it is expected that the new radio beacon will enable vessels to determine their exact positions in foggy weather, avoiding many dangerous reefs thereabouts.

Further about Radio Beacons

By OSCAR C. ROOS, M. E.

Editor, THE WIRELESS AGE,
N. Y. City.

Dear Sir:

May I intrude on your valuable space in order to present to the readers of my article on "Radio Beacons" (page 47, October Wireless Age), some criticism thereof and my reply thereto?

I submit this matter to your attention because in spite of the fact that Dr. G. W. Pickard was—with John Stone—among the first to use the loop for direction finding in this country, there is a general impression that the Navy is the pioneer and authority on this branch of radio research and practice.

It is only common justice to call attention to the fact that the Radio Beacon System has been the subject of attack and its development has been hindered by widespread propaganda, such as meets all successful rivals of well-established conventionalized systems.

My correspondent among other things, makes this point: "The problem you treat of is one of the fundamentals of piloting. It is known as the 'three point problem' and can be plotted with a three-arm protractor with a great deal less expenditure of time and energy than by the method you describe." To this I would remark that I am quite well aware of the method, which I used in 1897, but find that the use of a double protractor-compass arrangement—which was not described—is just as quick, and the arrangement costs about one-third of the price asked for the standard "three-arm" arrangement. It is also lighter.

The use of scale and compass work was recommended for those whose knowledge of geometry would bring out the principles more clearly. It takes less than 30 seconds to locate the ship when the base angles are known.

Again my correspondent says: "The shore compass stations are used by the Navy indeed, but you did not mention that every Naval vessel is equipped with a compass, too. After years of experiment with both systems, the Navy believes the shore stations to be the more accurate. It almost stands to reason." To this I would say, the latest technique of the Radio Beacon System requires no compass whatever. It is superfluous to mention a compass in this connection and I purposely refrained from doing so.

In spite of some opinions to the contrary, the undeniable advantage of permitting *continuous* readings is peculiar to the Radio Beacon System. Any fairminded observer who has noted the relatively slow process used—for example—at the N. Y. City charting rooms, will have no doubt whatever on this point.

What hard-headed business managers think of the Radio Beacon System is indicated by its adoption on Standard Oil tankers. It was developed by engineers who demonstrated radio direction finding to the Navy in 1908.

To deprecate it is to call public attention to its merits.

Very truly yours,

O. C. Roos.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Guglielmo Marconi
President

H. L. Welker
Secretary

Founded to promote the best interest of radio communication among wireless amateurs in America

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The Milwaukee Radio Amateurs' Club, Inc.

THE M. R. A. C.'s technical committee investigating and reporting at meetings is now the largest and most active in the society. Mr. Doll is chairman.

Reports such as, "The Relative Efficiencies of Battery-Charger Rectifiers," and, "The Remotely Controlled System of Station 9AAP," are typical of this committee's work.

A notable example of the addresses given before the society is, "Magnetism and Some Original Experiments in its Manifestation," by Rev. John B. Kremer, professor of physics and director of station WJAZ, Marquette University. In conjunction with this a contest in defining technical terms was also popular.

A recent membership drive under the leadership of F. W. Catel, 9DTK, was very successful. A large number of Milwaukee County non-member amateurs were induced to join the club and the American Radio Relay League of which this society is a local section.

The traffic committee solicits reports of QRM for investigation. All communications to the club should be addressed to its general office, 601 Enterprise Bldg., Milwaukee, Wis., or its officers may be interviewed at the weekly meetings which are open to the public.

Romance for Editors

LETTERS from distant lands come in sounding the far-away call of the inevitable amateur, and lack of space, alone, prevents our publishing them in full.

From Grahamstown, Africa, S. W. Watson reports his reception of American broadcasting, saying that amateurs in Cape Town have recently heard music and speeches in a foreign language.

J. Bishop of Norfolk, England, writes that he has heard WGY and other American stations with only four tubes and an indoor aerial, two stages of radio frequency and one audio.

Amateurs In Continental Europe to Be Our Playmates

THE American Radio Relay League expects co-operation from the American amateurs during the Trans-Atlantic tests, December 22, 1923, to January 10, 1924, in an effort to promote better amateur communication between America and Europe.

To facilitate receiving at this end the French and British amateurs will transmit on alternate nights, the transmission hours from 8:00 P. M. until 1:00 A. M., Eastern Standard Time, the French starting the tests on December 22. Since the efficiency of our amateur transmitters was adequately proved last winter there is no reason why our fans, however enthusiastic, should "break-in" during the twenty days of testing.

By way of special inducement to insure "quiet air," $3,500 worth of prizes are to be awarded for the best reception reports turned into American Radio Relay League Headquarters, 1045 Main Street, Hartford, Conn.

Hears Across Continent on One Tube

DONALD S. REINHARDT, a fifteen-year-old fan who lives in Llanerch, Pa., recently tuned in KFI, Los Angeles, Cal., while using only a detector tube.

"Shortly after the storm had let up," he said, "I started to tune in on two tubes, but that made the static too loud, so I cut down to the detector tube. I tuned in about eleven stations, including Chicago, Davenport and Kansas City, and then I decided to begin all over again.

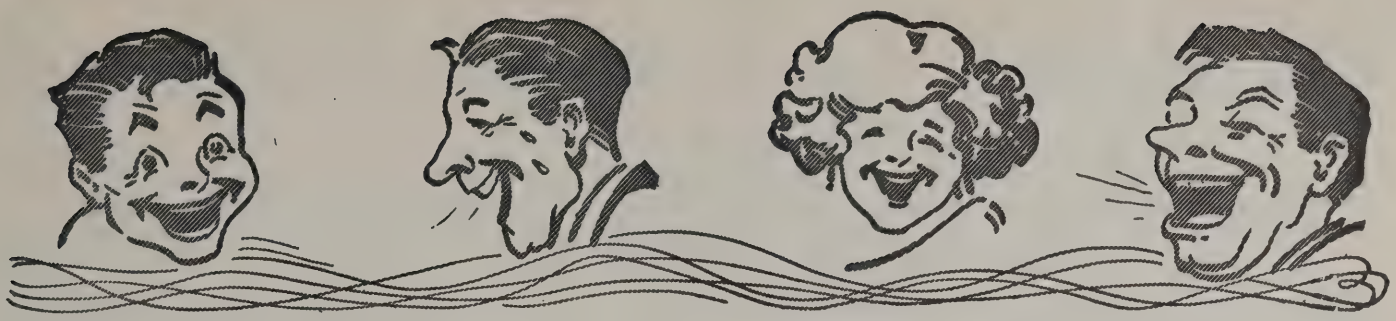
"I turned the condenser dial to zero and gradually advanced it toward the 100-degree mark. The first station that came in was one at Knoxville, Tenn., which was signing off. I moved the condenser a trifle more and caught a faint carrier wave I tuned it in and increased the volume by means of the plate variometer and heard orchestra music.

"In a few moments the music stopped and I waited for the announcer. He said 'The next and final selection will be Bebe.' The orchestra played it with a man singing the words of the chorus. Again the announcer spoke and this time he said, 'This is Station KFI, Los Angeles, Calif., signing off. Good evening, every one.'"

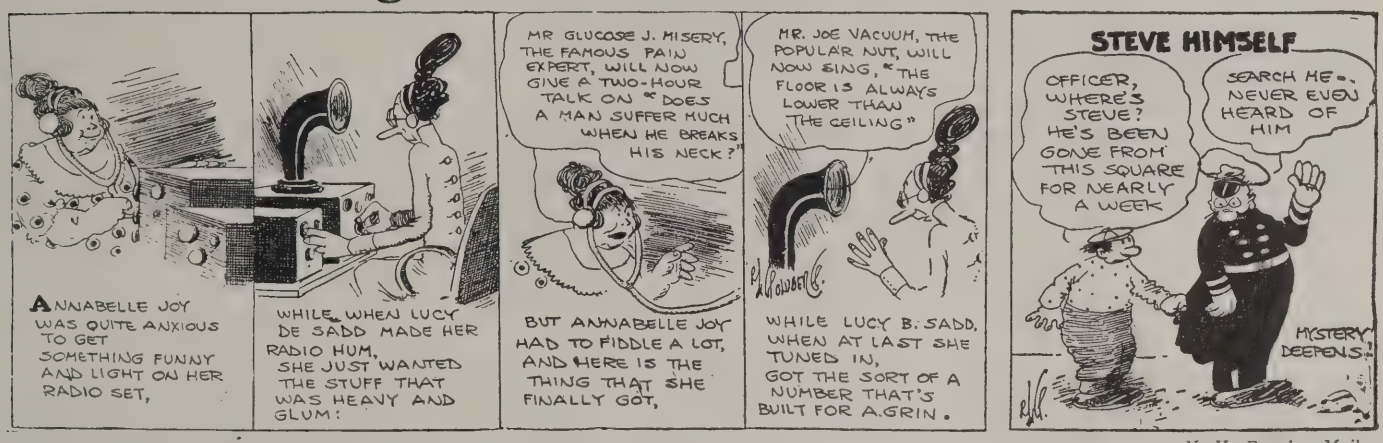
"I had the station between 11:30 and 12 o'clock and there can be no mistake about it as the words were plainly heard.

OFFICIALS OF THE AMERICAN RADIO RELAY LEAGUE

Seated, left to right: A. A. Herbert, K. B. Warner, F. H. Schnell. Standing: C. A. Service, Jr., J. K. Bolles, E. C. Adams, F. C. Beekley, S. Kruse and F. H. Mason



Laughter on the Radio Wave


ANNABELLE JOY WAS QUITE ANXIOUS TO GET SOMETHING FUNNY AND LIGHT ON HER RADIO SET,
WHILE WHEN LUCY DE SADD MADE HER RADIO HUM, SHE JUST WANTED THE STUFF THAT WAS HEAVY AND GLUM!
MR GLUCOSE J. MISERY, THE FAMOUS PAIN EXPERT, WILL NOW GIVE A TWO-HOUR TALK ON "DOES A MAN SUFFER MUCH WHEN HE BREAKS HIS NECK?"
BUT ANNABELLE JOY HAD TO FIDDLE A LOT, AND HERE IS THE THING THAT SHE FINALLY GOT,
MR. JOE VACUUM, THE POPULAR NUT, WILL NOW SING, "THE FLOOR IS ALWAYS LOWER THAN THE CEILING"
WHILE LUCY B. SADD, WHEN AT LAST SHE TUNED IN, GOT THE SORT OF A NUMBER THAT'S BUILT FOR A GRIN.
STEVE HIMSELF
OFFICER, WHERE'S STEVE? HE'S BEEN GONE FROM THIS SQUARE FOR NEARLY A WEEK
SEARCH ME — NEVER EVEN HEARD OF HIM
MYSTERY DEEPENS!

N. Y. Evening Mail

Ain't It Grand?

By Jack Bront

"Come, dear, dinner is getting cold and it's Nora's night out."

"Mm-m."

"John! Are you coming?"

"Just a min—" turning the knobs.

"Oh, that old radio set"

Silence.

"JOHN! Do you hear me?"

Abstractedly— "Just as plain—WJZ! —er WHAT, dear?"

"I suppose you think more of that old radio set than you do of me."

"Yes! Yes!—It IS KDKA! —Coming, dear."

"Brute! I'm going to leave this house forever. You want me to go?"

"Of course!—It is KDKA all right!"

"I'm going to pack this minute!"

"Hooray!—Here's WEAF!—Sure, Jane. Er-er What were you saying?"

Sobbing from above as the trunk lid slams shut, ready for departure.

"Oh, Jane! I've got Wanamaker's, WANAMAKER'S! Where are you? Jane!"

Silence and sobs from above.

"Oh, Jane! Wanamaker's got the greatest style show of the store! Styles just in from Paris!"

Tremulously—"Y-y-yes?"

"YEAH! Let's go down and pick out that wrap you wanted."

"Well—" reluctantly.

"Just fine, eh, old girl?"

"Uh-um! You're a dear John, and isn't that radio just grand?"

"I'LL say so. (Gr-r-r-r)."

Switches

SWITCHES may be made of metal, green wood, and hair. The use of each is different, but fundamentally all deal with electricity. Metal switches decide in which wires electricity shall flow, if any. Green wood switches generate a sensation of electricity in the hide of the small boy to which they are applied. Hair switches are almost obsolete but their theory is based on the production of electric impulses in the eye, spinal column and other parts of the beholder, generating an irresistible attraction, possibly of a magnetic character. Metal switches are frequently found in the home, while green wood switches flourish in the woodshed. Hair switches wave in beauty and other parlors, and are worn by the owner during her public appearances. They sleep on the bureau at night. Only the wood switches give pain, though sometimes the after effects of hair switches may not be pleasant. Metal switches are progressive citizens, illuminating the home, lighting the dark places of earth, turning the wheels of industry and commerce, and, when used in radio apparatus, entertaining and educating millions. When a switch of this kind is used it is customarily said to be "thrown," but there is no "bull" about this.

One of the advantages of radio oratory is that the speaker never knows when he is hissed.

Bulbs

BULBS may be made of glass, rubber, or vegetable matter. The bulbs of vegetable matter are subjects of deep interest to commuters and florists. They are planted in the ground and produce beautiful flowers in due course of nature, the weather, insects, herbivorous animals and visiting dogs, cats and chickens permitting.

Rubber bulbs are attached to various instruments of torture such as atomizers for dispensing perfume and other medicine for body and soul. In former times, rubber bulbs were also essential to a certain type of horn which was supposed to make more noise than the automobile to which it was attached, or than the pedestrian at which it was honked.

Glass bulbs have much less in them than other kinds, but much more comes out of them. Some glass bulbs produce light to shine upon the pathway. Others are more dim but possess the marvelous ability of transmitting or receiving man's speech and music across untold miles of space without the aid of wires. These are the most expensive and important bulbs of all.

The radio storm created by WGY, in the production of "Peg o' My Heart" as a radio drama, was so realistic, according to Martin L. Wyman, Jr., of Gaysville, Vt., that his father took off his headphones, saying that he didn't care to listen in during a thunderstorm.

The Wireless Age Push-Button Receiver

By John R. Meagher

To Mr. Lee Galvin of the RCA belongs all credit for originating the "Push Button Receiver." Mr. Galvin wished to give as a present to a friend a radio receiving set that would be simple and positive in operation. So he set about to devise such a receiver—and he succeeded! The photographs and text describe one adaptation of his system.—J. R. M.

IMAGINE a three-circuit regenerative receiver without variable controls!

Imagine a three-circuit regenerative receiver that doesn't re-radiate!

Imagine a complicated three-circuit receiver that a child can operate!

Imagine a receiver so designed that pushing one button lights the filaments, selects the proper wave-length and the proper regenerative adjustment for a certain station; another button for a second station and a third button for still another station!

That's what THE WIRELESS AGE "Push-Button" receiver does!

It's a standard three-circuit regenerative receiver modified as shown in the circuit diagram, figure 1.

Coupling between the plate, grid and antenna inductances is fixed. Three sliders on a portion of the secondary find the proper value of inductance to "tune in" any three stations. Three variable resistances in series with the sliders serve to adjust the degree of regeneration and the output volume. Three simple switches are used to select any one of the three slider-resistance circuits and at the same time complete the filament battery circuit.

That's all there is to it!

THE CIRCUIT

Figure 1 shows the complete tuning circuit and figure 6 represents the special home-made inductance. All coils are wound on one form; the tickler of 40 turns at one end, then a portion of the secondary—40 turns, next the untuned antenna coil—15 turns and finally a spaced winding forming the remainder of the secondary. Three sliders are arranged over this section which is wound with bare wire, No. 22, spaced with thin fishing cord.

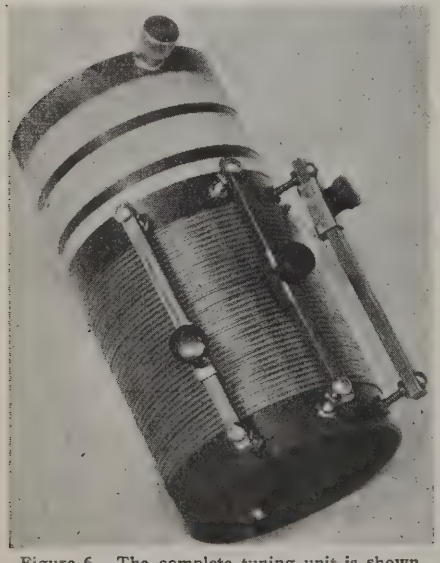


Figure 6. The complete tuning unit is shown here. Coupling between the three circuits is fixed and sliders are used to vary the inductance of the secondary

HERE is a receiver that is 'way ahead of the game! With it, it is possible to select any one of three stations by merely pushing a button—that's all!

It is an ideal set for real enjoyable entertainment—no mechanical or electrical skill whatsoever is required in its operation.

And it's easy to make—and cheap, too.

* * * * * *

We see the time when receivers like this, in locked cabinets will be rented to subscribers or equipped with nickel-in-the-slot devices for public use.

THE EDITORS.

A child can operate it

The dectector and amplifier are of standard design; in order to simplify the construction, no rheostats or jacks are used.

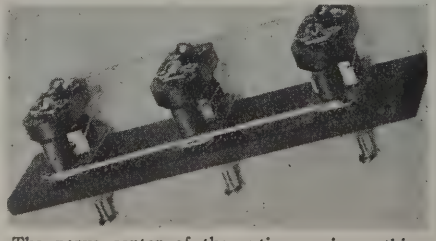
THE TUNING UNIT

The winding form of bakelite, 3" diameter, 6" long and 1/16" thick must be drilled for mounting screw holes (No. 27 drill), slider supporting screw holes (No. 27 drill) and wire fastening holes (No. 60 drill). All of these are shown in the sketches, figures 3 and 4.

Note that a space of ⅛" is provided between the coils in order that the separate leads may be distinguished more readily: Because of the slider rod supports, ½" is allowed between the antenna inductance and the spaced portion of the secondary.

In winding, leave about 6" for leads and secure the ends of the coils by threading the wire in its fastening holes. Wind the tickler first and then (in the same direction) the untapped section of the secondary and the antenna inductance. The spaced portion of the secondary is very easy to wind; secure the end of the cord and wire in the fastening holes, and make sure that both the cord and wire are free to unwind (either by arranging the spools on an axle or by laying both cord and wire full length along the floor). Lay them on the form side by side and turn the form with one hand, guiding the wire and supplying the necessary tension with the other hand. When the entire winding space of 3" has been utilized, cut the wire and cord and fasten the ends in the holes. No connection is made to this end of the wire.

The ends of the secondary that are separated by the antenna coil should be soldered and after the three sliders and rods have been arranged in place there should remain eight connections; two for the "tickler"; one for the grid; one for the ground; one for the antenna and the three sliders for the filament. And take care in arranging the sliders that the contact makes connection with but one turn at a time and that it has sufficient "spring" to insure positive connection.



The nerve center of the entire receiver: this is the push-button strip

After "drying out" the unit in an open oven a light coat of collodion may be applied to the cotton covered windings, but not to the spaced section of the secondary as the fishing cord is already water-proofed.

Put the form away until the detector and amplifier and push-button sections have been made.

THE PUSH-BUTTON STRIP

This is the "nerve center" of the entire receiver for it is the only visible means of "wavelength" selection and also automatically selects the regenerative adjustment and opens and closes the filament battery circuit. In addition, it is the easiest part to make!

The strip is of bakelite (though hard wood would be satisfactory) ½" wide, 6" long and ¼" thick. It is drilled (figure 5) for three Cutler-Hammer battery switches which are arranged with the long sides parallel. The dust-proof fibre casings on the switches are removed and the three bridging "U" shaped shorts are connected to each other and to the metal frames with flexible leads. (This is connection 5 in figure 1.) The three lower terminals of the switches are connected together with a bus bar. (This is connection 4 in figure 1.) There remain three separate contacts, one on each switch to which the sliders and potentiometers are connected (figure 1).

THE DETECTOR AND AMPLIFIER

If it is desirable the detector and amplifier may be mounted in a separate cabinet; any detector and two-stage amplifier may be used if connections for a "tickler" are provided.

However, in order to make the entire receiver compact, both the tuning unit and tube section should be laid out on a base of hard rubber or wood in the manner of the receiver illustrated. This panel is only 7 by 10 inches, but a larger one is specified in order that plenty of room will be available for fully mounted audio frequency transformers.

Gather together all the parts and arrange them on the panel in the best manner. Then mark and drill the holes.

Note that connections to the sockets are brought through the panel and in this way wiring is restricted to the under surface. This is done by replacing the terminals with longer brass screws (⅝", 6/32) which will extend through the socket and panel. Small 6/32 hexagon brass nuts are used to clamp the contact springs in place and the spring, nut and screw

MATERIAL

The trade name of the parts used in the "Push Button" receiver are given in parentheses; however, one should not hesitate to choose other makes if they are of equal merit.

- **3 standard sockets. (Paragon).**
- **3 battery switches. (Cutler-Hammer)**
- **2 audio frequency transformers. (General Radio)**
- **3 400-ohm potentiometers. (Tilman)**
- **7 binding posts. (Eby)**
- **1 sub panel, 7"x14"x3/16". (Radion)**
- **1 switch strip, 1½"x6"x¼". (Bakelite)**
- **1 .00025 mfd. grid condenser. (Dubilier)**
- **1 1-megohm grid leak. (Radio Corporation)**
- **1 .0005 mfd. fixed condenser. (Dubilier)**
- **1 inductance, form 3"x6", ⅛ lb. No. 30 D. C. C. wire, ¼ lb. No. 22 bare soft drawn copper, spool of thin fishing cord, 3 sliders and three 4" slider rods.**
- **4 strips of bus bar.**
- **2 strips of black cambric tubing.**

are soldered together to prevent loosening and to insure a perfect connection.

Four holes, identical with those in the socket are drilled in the panel and the projecting screws go through them and are clamped with other hexagon brass nuts. These serve not only for connections, but also as a means of fastening.

Seven connectors, consisting of brass machine screws and nuts are arranged in the panel near the tuning unit. Flexible connections from the unit are soldered to them and they are wired underneath to the rest of the circuit.

Screw the push-button strip in place and wire the entire receiver, using bus bar and soft drawn copper covered with small black cambric tubing.

Finally, attach the tuning unit to the panel with small brass machine screws and nuts and solder the leads to the proper terminals.

The receiver should be placed in a cabinet which may have a polished wood front—only the three push buttons will show. Small card holders should be arranged above each button and an appropriate card containing the name or call letters of the station inserted in each one. Incidentally, the cabinet should be provided with a hinged top as it is necessary to get at the "works" when the receiver is installed.

OPERATION

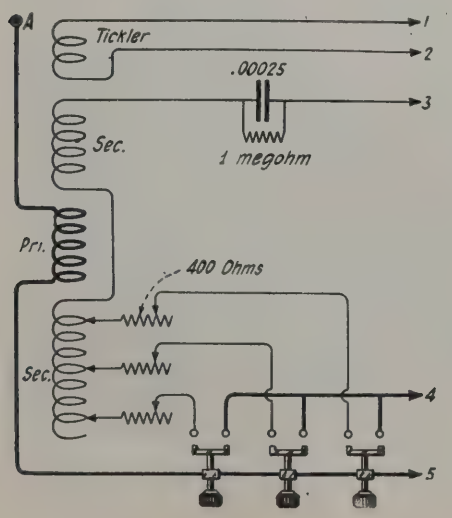
UV-201A (C301-A) tubes are used throughout so a storage battery of 6 volts with a six-ohm rheostat in one lead should be connected to the A battery binding posts on the receiver.

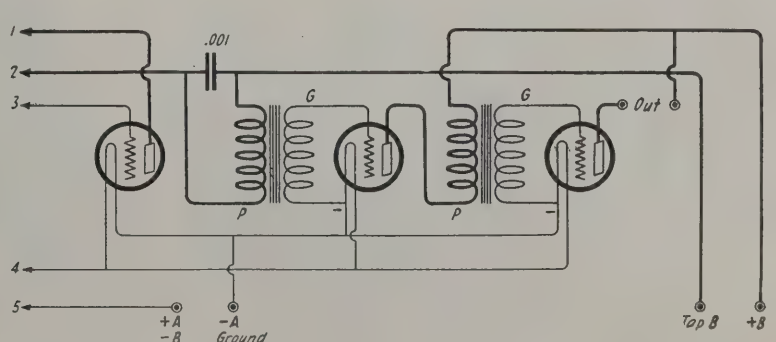
Connect the B battery, loud-speaker, antenna and ground to the proper binding post.

Set all three levers so no resistance is in series with the sliders and the filament.

Then, with one Cutler-Hammer switch "out" vary the slider connected to that switch until the "carrier wave" of a station is heard. Leave the slider there and increase the resistance of the "potentiometer" connected to that slider until the whistle ceases and the broadcasting is audible. Further increase of the resistance will decrease the signal strength so the desired volume may be secured by manipulating that control. Try readjusting the slider a turn or so and leave it in the best position.

Push in that button and the filaments will "go out." Pull out one of





Figures 1 and 2. Note the remarkable simplicity of the circuit used in the push-button receiver. As may be noted in Figure 1, three switches are so arranged that they may cut in separately a certain amount of resistance and a certain value of inductance for a certain wavelength. In addition the filament circuit is made or broken by the action of the switches. Complete details about this unique system are given in the text

the other buttons; the filaments will again light; and proceed to tune in some other station—preferably a local. Adjust the volume as before. In a similar manner, select a third station and adjust the signal volume.

In other words, all we do is to adjust one slider and one resistance at a time, the slider determining the wavelength and the resistance the amount of regeneration desired.

Having calibrated all three "buttons" so as to receive the three best stations, shut up the cabinet, lock it if necessary, and that's all!

The Push-Button Receiver is the second of a series of sets made in THE WIRELESS AGE *workshop and described in detail in* THE WIRELESS AGE.

We have many splendid receivers in the process of construction; all of them are of the latest type; some have unique features which make them not only efficient but also new and interesting. To mention a few: One is a one-tube reflex that is just about the best one-tube set that has as yet been described; another is a more complicated tuned radio frequency amplifying receiver that is capable of exceptionally long distance reception; there is a splendid super-heterodyne, too, that is cheap and easy to make.

All of these and a wealth of technical constructional articles are planned for near issues of THE WIRELESS AGE.

The Push-Button Receiver is on display in The Wireless Age office at 326 Broadway, New York City. Come in and examine it when you are in the city.

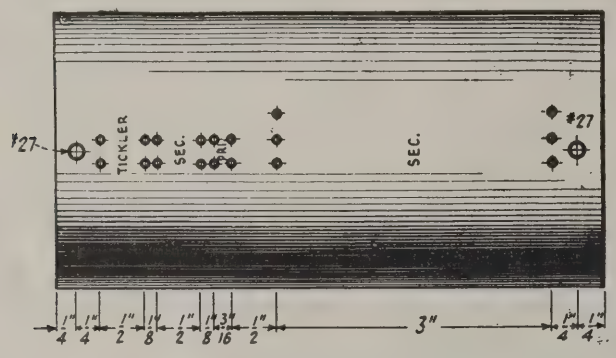


Fig. 3

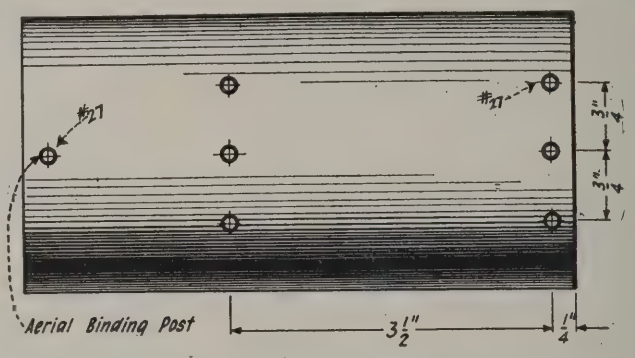


Fig. 4

Figures 3 and 4 above. These sketches represent the winding form for the tuning unit

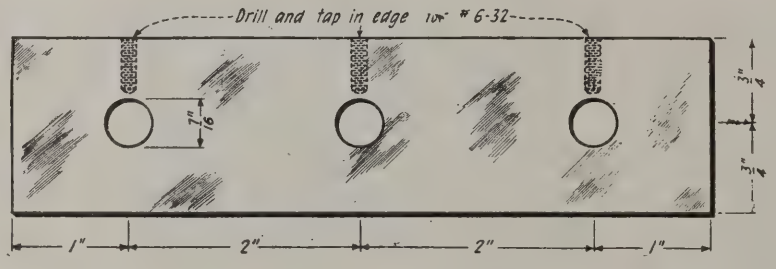
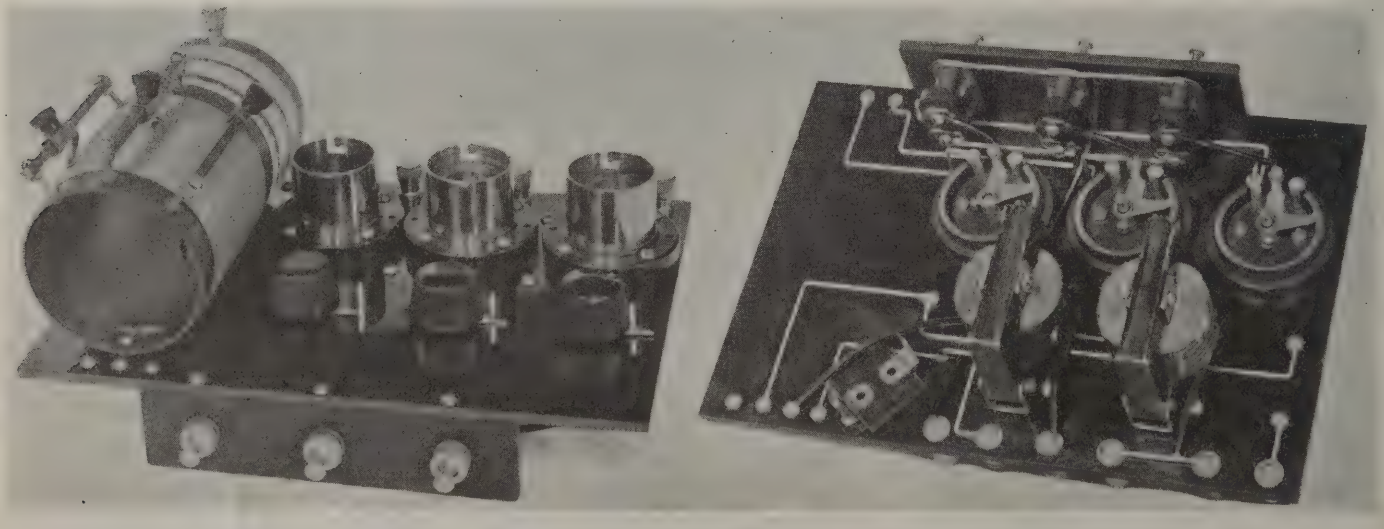


Fig. 5

Figure 5. Panel layout of the push-button strip



The inside works of The Wireless Age push-button receiver; the left hand view shows the sub-panel with the tuned unit and push-button strip in place. The knobs control the amount of resistance in the circuit. A bottom view is shown on the right-hand side and one may note the simplicity of the wiring

Radio Frequency Amplification, Regeneration, and the Single Circuit Receiver

By Donald Gordon Ward

Associate Member Institute of Radio Engineers

FROM some unknown point the idea has been gradually seeping into the amateur fraternity that it is impossible to employ radio frequency amplification with regeneration and especially impossible to employ radio frequency amplification with the single circuit receiver. Just where this idea originated, no one seems to know, but it is to be supposed that it was because some experimenter who had very little experience with radio frequency amplification tried to apply one of the original type of radio frequency circuits to his regenerative receiver, and not being able to accomplish anything in the way of results, he immediately drew the conclusion that it was impossible to employ radio frequency amplification with any type of regenerative receiver.

The first statement to be made in connection with this article is that this idea is false and one which should be immediately dispensed with before it does any more harm to the radio game.

Another false impression which has been held by many radio experimenters, is that it is impossible to use radio frequency with the single circuit receiver. The time and place of birth of this idea is also rather vague, but it probably also came from the same source that was responsible for the first erroneous idea concerning regeneration and the radio frequency amplifier.

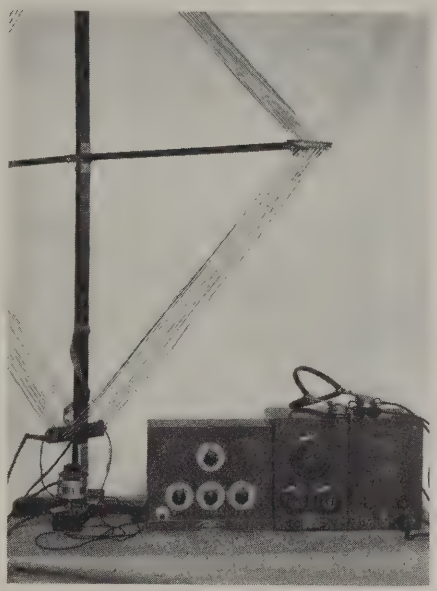


Figure 1. Some of the apparatus used in the first experiment which the author conducted to learn if radio frequency amplification could be used to advantage with a regenerative receiver

During the process of the unfolding of this article we will not only show how to employ regeneration with the radio frequency amplifier and how to use radio frequency amplification with the single circuit receiver, but we will also demonstrate the use of radio frequency amplification, regeneration and the single circuit receiver, at one and the same time.

This article is the result of a number of experiments with standard apparatus at the Radio Institute of America, which extended over a considerable length of time and is very convincing as to the results which were produced. Various types of signal energy were received, such as the radio frequency from a buzzer driven wavemeter, signals from a distant spark transmitter, signals from a distant C.W. transmitter, and signals from a small C.W. calibrated oscillator using both A.C. and D.C. as the source of supply of the plate potential.

The following apparatus was employed in making the tests.

One standard RCA short wave loop type AG-1380 with variable condenser. One 3-stage radio frequency amplifier, General Electric Co., AA-1520. One Westinghouse RC receiver, complete with tuner, detector and 2 stages of audio frequency amplification. One General Electric single circuit tuner, type AA-1300. One General Electric detector and 2-stage audio frequency amplifier, type AR-1400. One single-circuit Armstrong regenerative receiver employing the Reinartz circuit.

The first set-up used is illustrated in the figure 1. The apparatus used was as follows, Radio Corporation loop with variable condenser, type AG-1380, General Electric, 3-stage radio frequency amplifier, type AA-1520 and Westinghouse RC receiver.

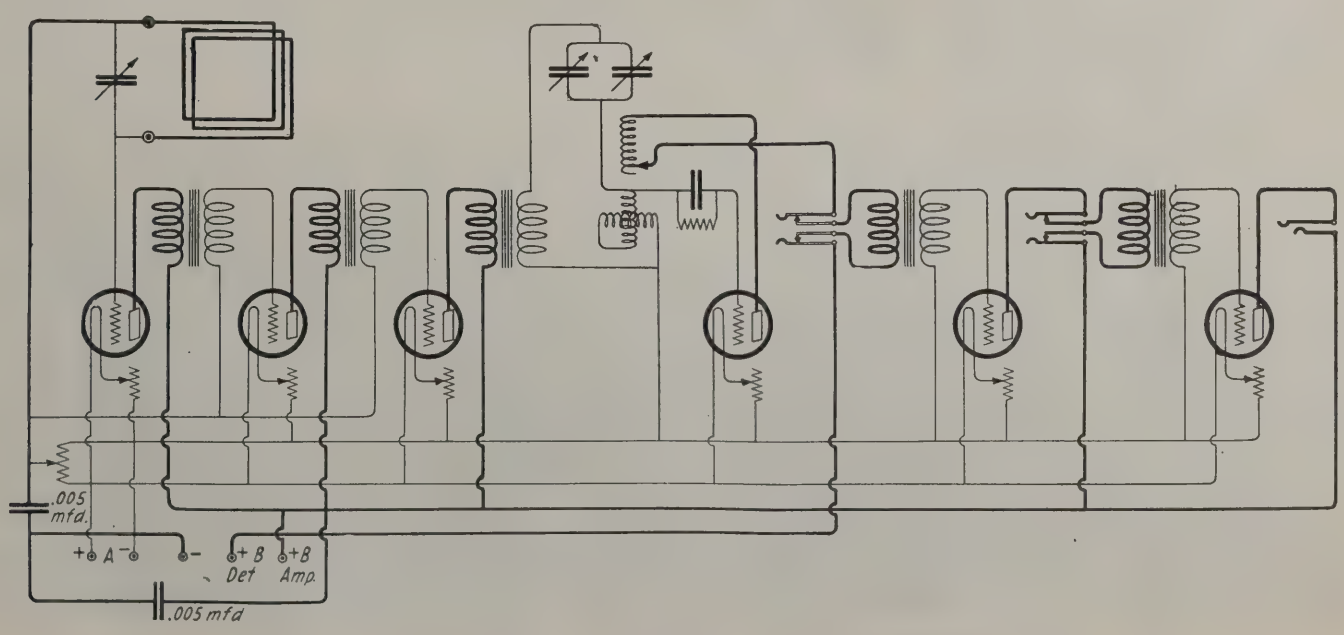


Figure 2. This is a circuit diagram representing the hook-up of the equipment shown above

The radio frequency waves were picked up by the loop and converted into radio frequency currents in the loop and condenser which formed the first oscillating circuit. The output of this circuit was fed through the three stages of radio frequency amplification and thence to the tuner of the RC receiver and from there to the detector, where it was rectified in the usual manner and then passed on to the audio frequency amplifiers. The circuit figure 2, gives the complete wiring diagram of this connection.

In operating this circuit it must be very carefully adjusted so that the radio frequency amplifier does not oscillate, for if two radio frequency signals are locally generated, one by the radio frequency amplifier, and the other by the regenerative receiver, and a third radio frequency is picked up by the aerial, a very curious conglomeration of sounds in the receivers will be the result. This is taken care of by means of the stabilizing potentiometer which is mounted in the radio frequency amplifier, and a small amount of experience will show just the proper adjustment for the best results in so far as signal reception and freedom from extraneous noises are concerned. The circuit should be adjusted by means of the stabilizing potentiometer, until, with the tickler coil adjusted to the minimum position, it does not oscillate.

The best test for oscillation is to tap the antenna post of the radio frequency amplifier, which under the conditions of this test is the input post of the radio frequency amplifier, marked G, or in some cases the unmarked terminal. If a click is heard in the telephones when this test is made, the circuit is in an oscillating condition and the stabilizing potentiometer should be adjusted until this is no longer heard. If it is found impossible to so adjust the potentiometer to prevent this oscillating condition, it is due to the fact that the tickler coil is causing the oscillation, so it should be temporarily short-circuited. The adjustment of the stabilizing potentiometer is quite critical, but after it has been once adjusted it is not necessary to move it unless new tubes are put into the radio frequency amplifier.

The next move is to remove the short circuit around the tickler coil, if one was put on, and adjust the tickler coil until the circuit again oscillates as will be shown by making the same test for oscillation as was made before. The circuit is now ready to be tuned.

If it is found that the signals from the local stations come into the loop with such an intensity that it is difficult to separate the stations one from another, the number of stages of radio frequency which are being used may be reduced by simply turning out the filaments of the radio frequency amplifiers. If only two stages of radio frequency are desired simply turn out the filament of the third stage radio frequency amplifier. If only one stage is desired, turn out the filaments of the second and third stages, but do not under any conditions remove the tubes from the sockets as this will cut out the signals entirely. With the filaments turned out and the tubes in the sockets the radio frequency energy is fed through the tubes, through the condensers formed by the plate-grid capacity of the elements of the tubes themselves.

One supreme advantage of the use

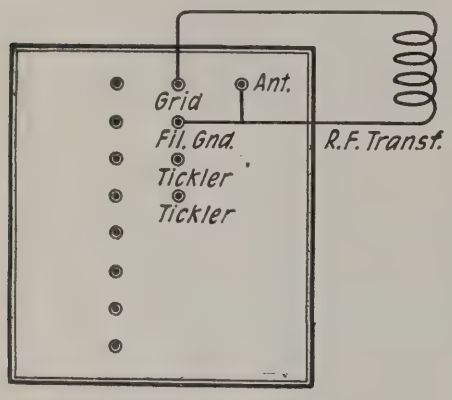


Fig. 3

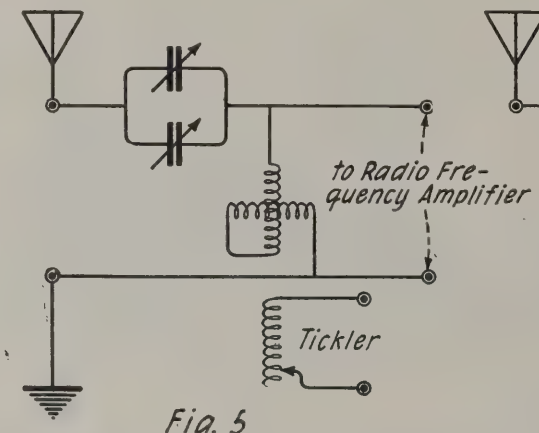


Fig. 5

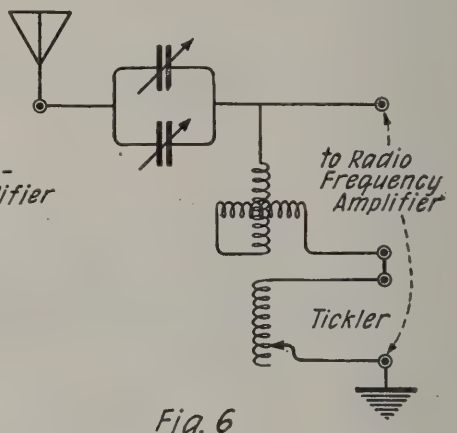


Fig. 6

Various tuning systems may be used in conjunction with the radio frequency amplifier

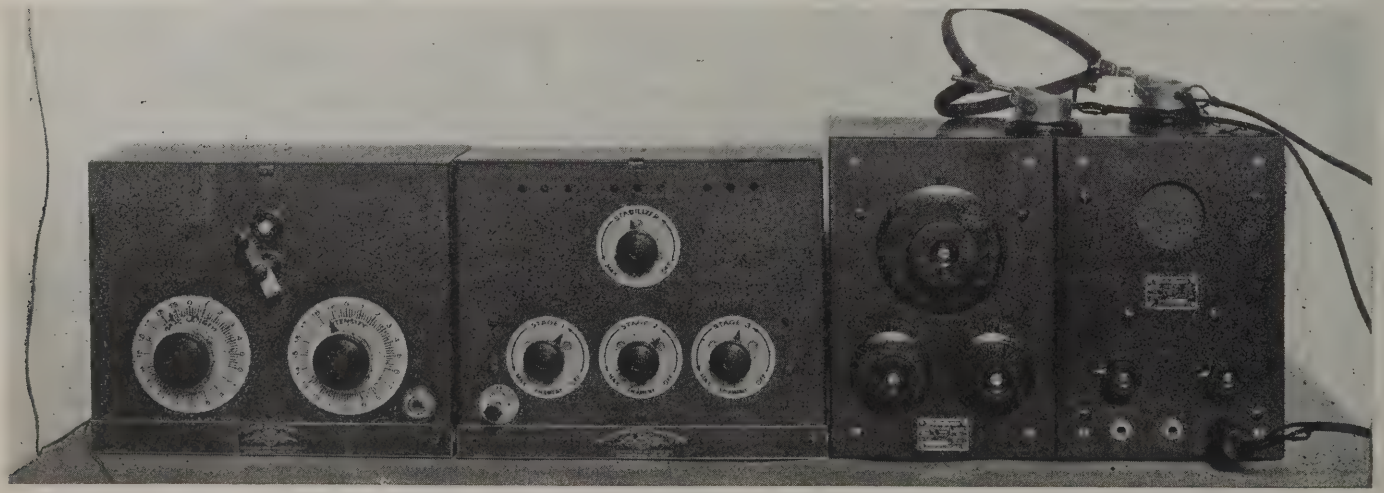


Figure 4. In his second experiment the author used a single circuit tuner instead of the loop—and the set worked well

of the radio frequency amplifier, outside of the fact of the increase in receptive range, is the action of the radio frequency amplifier in preventing any radio frequency which might be generated in the receiver itself from passing out to the antenna and interfering with all of the receivers in the immediate vicinity.

It might be mentioned in passing that very few of the receivers which are in use at the present time are handled with any consideration of our neighbors' feelings. If we wish to receive signals, we simply turn up the tickler coil to a point that throws the receiver into an oscillating condition which gives the neighbors who are listening in on the same program around us the "benefit" of our radiated energy. The entire basis of this trouble lies in our wishing to push our receivers to the maximum limit without any consideration of the fact that the overloading of our receivers and amplifiers results in deterioration of our outfit, which, though it is not immediately apparent, finally shows up in the form of various breakdowns, such as burned out transformers, burned out receivers, connections which open and close, giving rattles in the ear phones and many other troubles.

When it is appreciated that the receiver and amplifier tubes are meant for a certain service, and that any attempt to seriously overload them will not benefit the listener anything, but on the contrary will only damage his apparatus and produce the most horrible form of reproduction, then at last will the broadcast public begin to get real enjoyment from its reception of broadcast programs.

To return to our circuits, the General Electric receiver may be used with its accompanying detector and audio-frequency unit in place of the Westinghouse RC receiver. The diagram of this connection is not given as it is almost exactly the same as that of the Westinghouse unit.

A second method of using the same units as were referred to in the first set of tests, includes the Westinghouse RC set with the primary tuning condensers—which are normally connected in series with the antenna circuit—connected in shunt with the primary. This may be accomplished by making the input and output connections to the receiver as illustrated in figure 3, which gives a view of the RC set taken from the back and shows the location of the binding posts.

If it is not desired to use the loop aerial as a pick-up device it is possible to use another tuning element with an aerial and a ground instead of the loop and tuning condenser. Figure 4 illustrates this set-up.

The diagrams, figures 5 and 6 show the connections necessary to use this tuning element. It is unnecessary to include the radio frequency amplifier or the regenerative receiver with the detector and audio frequency amplifier as the connections of these pieces of apparatus remain unchanged. In the diagram figure 5, the tuner is used with its normal connections, that is, with the aerial and ground connected to the aerial and ground posts of the tuner while the output of this tuner is connected to the input of the radio frequency amplifier unit.

In the diagram figure 6 another con-

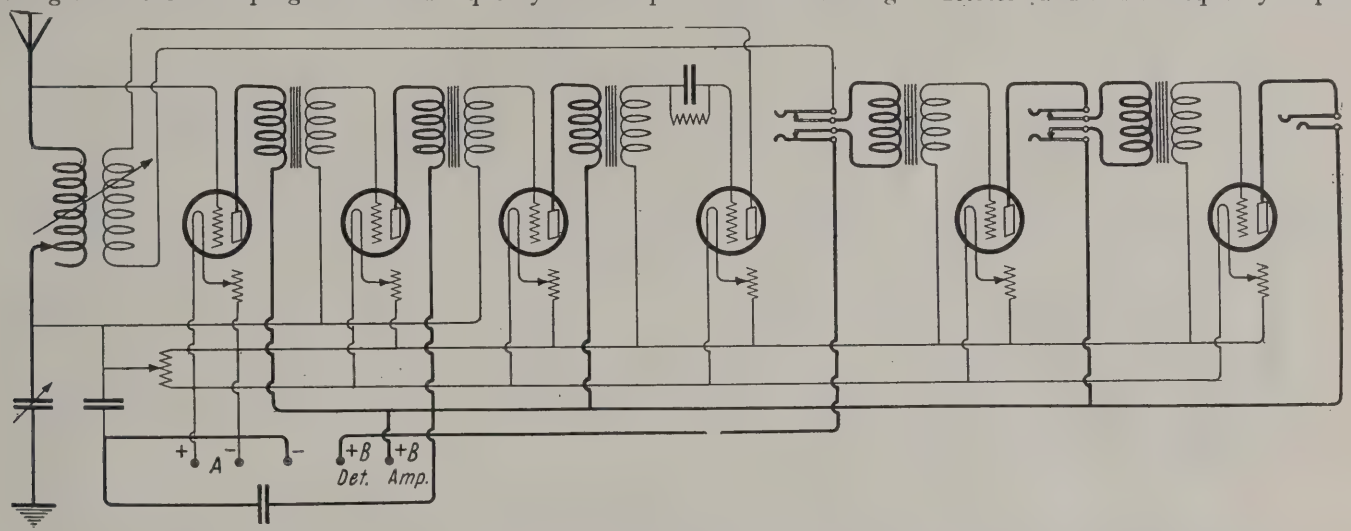


Figure 8. Hook-up of a single circuit receiver with three stages of radio frequency amplification and regeneration

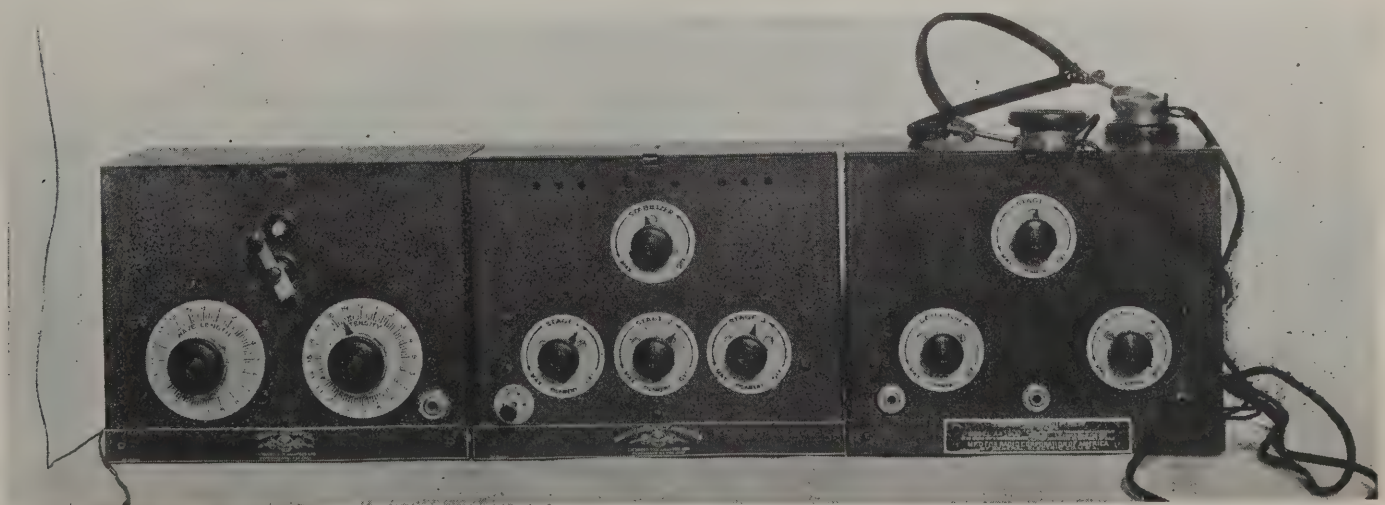


Figure 7. This is the equipment represented in the circuit diagram of Figure 8

nection is shown in which the tickler coil is made use of as an additional inductance for increasing the wavelength of the antenna circuit in case we have a very short aerial and wish to receive on higher wavelengths than would otherwise be possible.

In case it is desired to still further increase the range of the receiver, the tuner may be connected as illustrated in the sketch figure 3, and the aerial and ground must then be connected to the grid and ground terminals respectively. A small aerial must be used with these connections, because if a large aerial is used, it picks up so much radio frequency energy that it is difficult to separate one station from another, while if a small aerial is used it may not be possible to go up to the higher wavelengths because we have not enough inductance and capacity. Therefore it is best to use the tuning elements with the maximum amount of inductance and capacity which they possess and connect them in a circuit where they have the real control of the tuning instead of having the maximum of the inductance and capacity in the aerial where it cannot be controlled.

It might be mentioned that it is possible to use the Reinartz receiver in place of either one of these receivers in the above tests and there is no reason to presume that it would not be possible to use any single circuit receiver though it is not considered in this article because no other type of single circuit was available for the tests and it was felt that it would be safer to stick to circuits that had been actually tested and not to include those circuits which, though according to all theory they should work in these setups, had not actually been tried and the results noted.

In a further set of tests the radio frequency amplifier unit was connected between the tuner, which is employed regeneratively and the detector and audio frequency amplifier unit. Under these conditions, instead of having only one radio frequency impulse, fed through the radio frequency amplifier, namely; the incoming radio frequency energy from the aerial, there are two:—first, the incoming radio frequency energy, and second, the radio frequency component of the plate current of the detector tube, when the tube is oscillating. As these two radio frequency impulses are only slightly off resonance relationship one with the other, one of them will be fed through as efficiently as the other. As the radio frequency amplifier will not pass any audio frequency currents, even if the audio beat note is present in the tuning elements it will not pass through the radio frequency amplifier and the beat note that will result must come from the beating together of these two radio frequencies after they reach the detector circuit.

As shown in figure 7 the apparatus used was the General Electric units throughout.

The diagram figure 8 gives the scheme of connections of this receiving equipment and in connection with this receiver it is well to mention some of the points to be observed in its operation. The first step is to tune in the station desired with the tickler coil adjusted in minimum position so that it does not oscillate. Next adjust the radio frequency amplifier until it does not oscillate as in the manner previously mentioned; now readjust for oscillating condition with the tickler coil. The least amount of regeneration that can be used while obtaining desired

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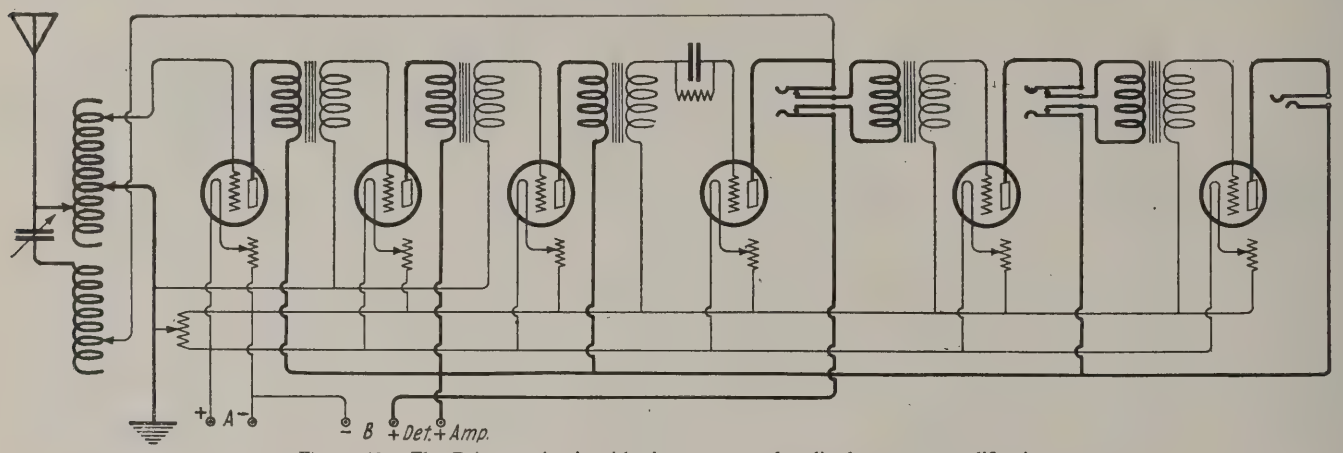

Figure 10. The Reinartz circuit with three stages of radio frequency amplification

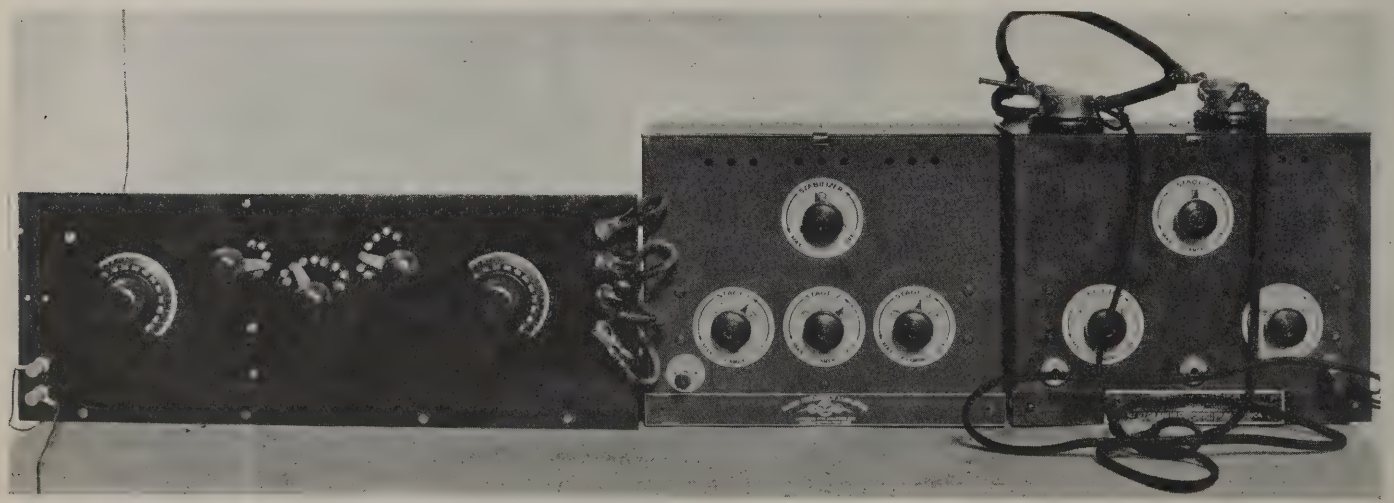

Figure 9. A Reinartz set connected to a General Electric three-stage radio frequency amplifier and a detector and audio-frequency amplifier

An Efficient Speech Amplifier and Its Application for Phone, ICW and CW Transmission

By K. M. McIlwain

THE popular theory in the past that it was absolutely necessary to have a D.C. generator or a bank of "B" batteries to supply the plate potential for the speech amplifier tube in radiophone work is fast dying out and the understanding and adoption of the circuit that I have here drawn out and am going to explain in detail will prove that the above mentioned popular theory is a fallacy.

I am under the impression that a great many amateurs are using 500-cycle A.C. as a source of power for their radio transmitters so I will carry on the following discussion assuming a 500-cycle source of energy, and explain how it can be used for the filaments and the plates of the tubes in the speech amplifier unit and then show how, after installing this system, it is possible to shift from phone to I.C.W. and then to C.W. by a simple switching arrangement.

Figure 1 is a schematic diagram of the speech amplifier unit, and after completing the discussion on this circuit, another schematic diagram will be shown of the oscillatory circuit and the method of coupling it to an antenna for greatest efficiency and stability of operation.

The Power Transformer

The Radio Corporation UP-1368 power transformer is perfectly alright for use in this circuit even though we have a 500-cycle source of supply. At first glance there may be a question in your mind as to the adaptability of this transformer to 500-cycle energy since it was designed for operation on a 60-cycle circuit. It will work efficiently on 500 cycles and I'll tell you why. To begin with I'll make the following statement: You can use a 60-cycle transformer on 500 cycles but you can't use a 500-cycle transformer on 60 cycles without overheating the core.

The magnetic flux threading the core of any transformer is equal to the product of the impressed voltage and a constant (100,000,000) divided by the product of the frequency and the number of turns in the primary of the transformer and another constant (4.44). Writing it out, the formula looks like this:

$$\text{Total flux} = \frac{Ei \times 10^8}{f \times t \times 4.44}$$

where: Ei = the impressed voltage
f = the frequency of the impressed voltage
t = the number turns in the primary winding.

In the design of transformers, a safe allowable flux density (number of lines of force per square inch of core area) is about 65000, therefore, the number of square inches necessary to carry the total amount of flux as determined by the above formula, is equal to that value obtained, divided by 65000. Writing this formula out we have:

$$\text{Sq. inches} = \frac{\text{Total flux}}{65000}$$

Going back to the first formula. The only value that we are interested in in this discussion is the frequency f, all the other values remain constant. If we were designing a transformer for duty on a 60-cycle source we would have the value 60 substituted for f in the first formula and if we were designing it for a 500-cycle source, we would have the value 500 substituted in place of f. Now, by comparison, it can be readily seen that by having 60 in the denominator of the formula under consideration we are going to have a value for the total flux that will be more than eight times the value we would get if we had 500 in the denominator instead of 60. Now, considering the second formula, we can see that with 60 cycles we would need more than eight times the core area that would be necessary for 500 cycles, so it can be readily seen that a transformer designed for 60 cycles will have more than enough core area for 500 cycles, while a transformer designed for 500 cycles will not have near enough iron to carry the flux that would thread the core if 60-cycle energy were applied to the primary. So you will be perfectly safe in using the 60-cycle transformer mentioned on your 500-cycle source of power.

SOME real, authoritative "dope" on amateur C.W. transmitters is given in this article by Mr. K. M. McIlwain, a noted expert on the subject. The information will be of much interest to 200-meter experimenters.

The beauty of using this transformer is that you really have three transformers in one. One secondary winding supplies the plate voltage for the two kenotron tubes, a second winding supplies the filaments of the two kenotrons with current (this winding being insulated for 1100 volts), and the third winding supplies the filament current for the 5-watt speech amplifier tube.

Rectifier

The rectifier tubes used are UV-216's and they are rated at 20 watts output. Two are used to give full wave rectification. A PR-535 filament rheostat is put in series with the filament lead of each of these tubes to get the proper control. This, of course, is necessary so that you will be able to prolong the life of the tube by cutting down the filament supply to get normal efficiency of operation with minimum amount of filament current. These rheostats should be connected into the circuit so that they each have their two resistance coils in parallel. In this way they each will offer a resistance of 1.5 ohms and will each carry a current of 2.5 amperes. No other way of connecting in this rheostat will do since any other combination is only rated at 1.2 amperes and as these tubes each draw 2.35 amperes there would be an unnecessary heat loss in the rheostat windings.

Filter

The wire to supply the plate voltage for the speech amplifier tube is tapped off the mid-point of the kenotron filament winding, but before it gets to the plate it passes through a refining or filtering process that irons out the

1000-cycle ripple that predominates at the start. If only one rectifier tube were used only one side of the 500-cycle wave would be rectified and we would only have one ripple per cycle, but when two kenotrons are used we have double or full wave rectification and consequently get two ripples per cycle which means in this case a 1000 cycles. The first series circuit that it comes to is a 1000-cycle trap which is no more nor less than an application of the much discussed anti-resonant circuit (wave trap) used in the antenna leads of receiving sets to eliminate undesirable transmitting stations while listening to some desired signal on another wave length. It is composed of a UP-415, 1. henry reactor in parallel with a .025 mfd. condenser. By substitution in the following formulas it will be seen that 1000 cycles is the frequency of a 300,000 meter wave and that 1. henry and .025 mfd. tune to this wave length.

$$\lambda = \frac{3 \times 10^8}{f} = \frac{3 \times 10^8}{10^3} = 300{,}000 \text{ meters}$$

$\lambda = 59600 \sqrt{LC} = 59600 \sqrt{1000 \times .025} = 300{,}000$ approx.

where: λ = wavelength

L = inductance in milli-henries (1. henry 1000 mh.)

C = capacity in micro-farads.

It is the property of a parallel circuit tuned to a given frequency to offer an extremely high impedance to that frequency when connected in series in the circuit containing energy of that frequency. Thus the trap offers a high impedance to the 1000-cycle ripple.

On either side of the trap, connections are made to two UC-488 condensers (1. mfd. each), the other side of these condensers being connected to the negative side of the rectified supply from the kenotrons, which is the mid-point of the secondary winding which supplies the plate voltage for the two kenotrons. It is to be noted that this negative side is kept off of ground as far as D.C. and speech frequencies are concerned, the only ground connection being a radio frequency ground through a UC-488, 1. mfd. condenser. The reason for this will be explained later.

A radio frequency choke coil is added between the 1000-cycle trap and the plate of the speech amplifier tube. This is simply another UP-415, 1. henry reactor.

Speech Amplifier Tube

This tube is a UV-202, 5-watt radiotron, one of the most popular tubes for amateur transmission. We now have, after the filtering that it has gone through, a pure supply for the plate of this tube. It is so far from 1000 cycles that we will call it D.C. This D.C. voltage depends upon the voltage that is applied to the plates of the kenotrons and the per cent. of rectified voltage to 500-cycle voltage to be expected is about 55 per cent. Therefore, if there is a potential of 550 volts on the plates of the kenotrons we would expect to get about 55 per cent. of that value or 300 volts on the D.C. side. A connection is run from the plate of this tube through a blocking condenser to the grid of the modulator.

The filament of this tube is supplied with current from the secondary winding of the power transformer set aside for this purpose. The mid-point of this winding is connected to the common negative. The grid is connected to one side of the secondary winding of a UP-414 microphone transformer. From the other side of this winding a connection is made to the negative bias battery which for this tube functioning under these conditions you will find to be best at some voltage between 6 and 9. The positive side of the bias battery is connected to the common negative, which in turn, is connected to the grid of the modulator tube through a UP-414, 1. henry reactor.

Microphone Circuit

This circuit is composed of a standard microphone and 6-volt battery in series with the primary of the UP-414 microphone transformer mentioned above. The battery may be either a 6-volt storage battery or one made up of four 1.5 dry cells in series. The storage battery of course is preferable although not absolutely essential. There is a side tone winding on this transformer which may be connected to the telephone receivers by means of a double-pole double-throw switch as shown in figure 1; this is desirable during transmission as it allows the operator a means of checking up on the operation of his microphone. This is really a very essential point because often in the course of conversation the operator will allow the position of the microphone, relative to the voice waves emitted from his mouth, to change so that he will be speaking into it at an angle. This will cause the microphone to function inefficiently and it will be noticeable immediately if the telephone receivers are connected to the side-tone winding.

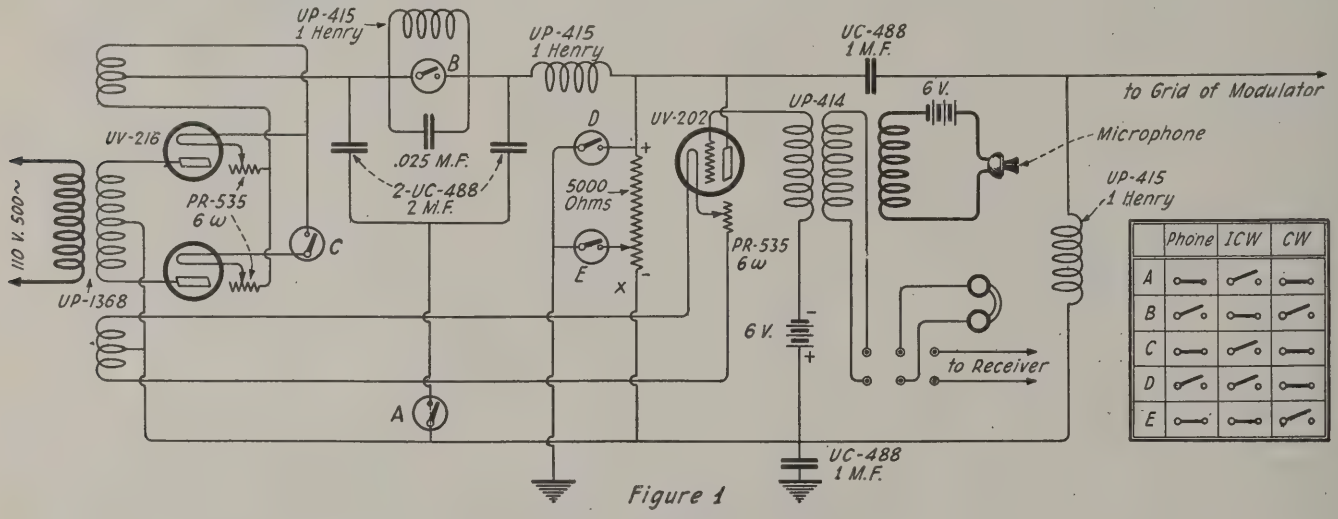

Figure 1

Complete circuit diagram of a splendid speech amplifier for amateur transmitters

The only way to talk into any kind of microphone whether it be in a radio phone transmitter or an ordinary land line telephone, is to hold the microphone in such a position relative to the voice waves coming from your mouth as to cause these waves to strike the diaphragm perpendicularly. The common practice so prevalent in many offices of carrying on a telephone conversation with the microphone up around the side of the face somewhere is mighty poor practice. If we are going to use a certain kind of apparatus we might as well use it to produce highest efficiency.

Before going on to describe the oscillatory circuit it might be well to add

(Continued on page 64)

THE TEST TABLE

A REGULAR MONTHLY DEPARTMENT OF AUTHORITATIVE INFORMATION ABOUT RADIO APPARATUS

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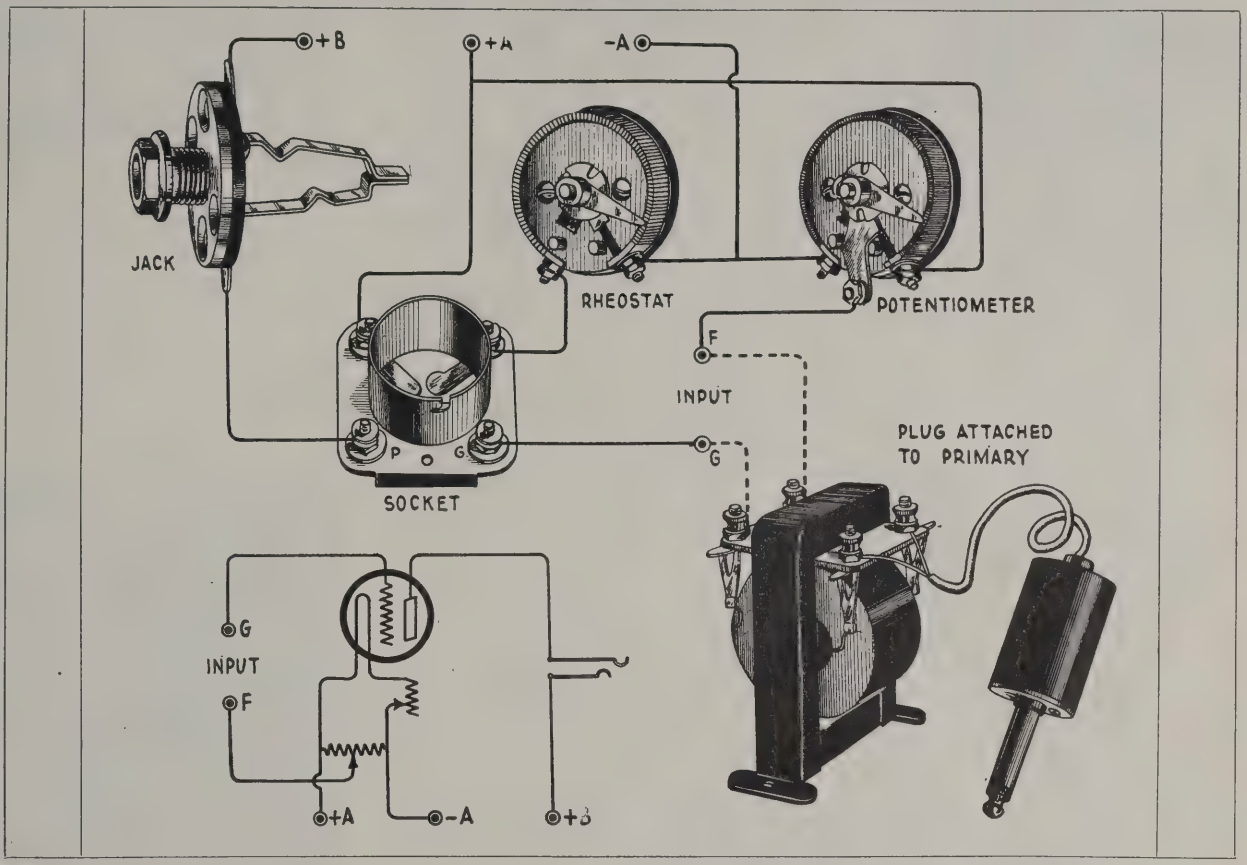
BY
R. P. CLARKSON
AUTHOR
RADIO DATA SHEETS



A UNIVERSAL TEST ASSEMBLY

Just a socket, a rheostat, a potentiometer, and a jack! These form a universal test assembly when connected together as shown in the picture hook-up and repeated in the diagram. From the plus and minus A binding posts, leads go to the A battery of your regular set. If you have less than about 80 volts of B battery, connect another block of B battery to the present amount. The minus of the new block will connect to the last plus of the old and the free plus end of the new block will go to the binding post marked plus B.

With a hard tube, an additional step of A. F. may be tried out. Connect the secondary of any A. F. transformer to the input of your test assembly, connect a regular phone plug to the primary and plug in where you usually plug in your receivers. You may have to reverse the connections of the plug to the primary so that the tip and sleeve of the plug will connect up right to the contacts in the jack. Put the potentiometer arm over against the minus post. The effect of various transformers may be tried and the correct one chosen.

The same hook-up makes a step of R. F. Just substitute an R. F. transformer for the A. F. Connect the secondary to the input. Connect the plug to the primary. Short circut the grid condenser and leak on your detector with a piece of wire. Put a grid condenser and leak on the test set between the input terminal G and the socket. Put the detector tube in the test set socket and the amplifying tube in your regular detector socket. Change the detector B battery lead to the binding post on the test set and the test set B battery lead to the detector post on the regular set. Turn the potentiometer arm over against the plus terminal, plug the transformer in on your detector jack and your head phones in on the test set jack and there you are. The plate variometer or tickler will also require short circuiting.

A VERSATILE HOOK-UP

With the test assembly, an amplifying tube and one each of R. F. and A. F. transformers, you can amplify the local programs by using the A. F. as shown. Then later in the evening, switch to the R. F. transformer as described and go for distance. Take care that the leads from the R. F. transformer are kept short.

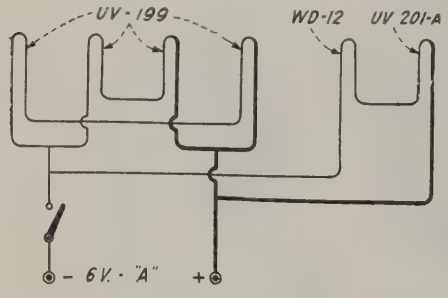
Every once in a while some old idea pops up as a new hook-up. You can try any of them with the test assembly shown. It has all the elements of any detector or any amplifier. Across the battery is a potentiometer so that the input lead from F may be carried either to plus or minus filament or to any intermediate point, thereby regulating the grid bias. When used independently, minus B battery will connect with plus A and Plus B goes as indicated.

To try out reflex, for example. Plug in on the test jack the primary of an R. F. transformer, connect its secondary, a crystal and the primary of an A. F. transformer in series, as usual, and connect the secondary of the A. F. transformer across from the input terminal G to the socket. Shunt this secondary with a .001 condenser, connect the input terminals to your tuner, and put your phones in between the B battery and the plus B binding post. Another .001 or .002 condenser across between the binding posts plus B and plus A will be of advantage. Use a hard tube.

Workshop & Laboratory

Filament Circuit for the Uni-Control

MANY amateurs wish to secure greater volume than the small UV-199 tubes in the Uni-Control afford. By the use of the circuit shown here, the second and third stages of audio-frequency amplification are used



in conjunction with a WD-12 and a UV-201-A tube, respectively. The total current consumption with this arrangement is approximately .37 amperes. This system will give louder reproduction than would be had if UV-199's are used throughout. The rest of the circuit may be exactly as shown in the description of THE WIRELESS AGE Uni-Control published in the December issue of THE WIRELESS AGE.

Mounting radio frequency transformers in tuned RF amplifiers at all sorts of peculiar angles seems to be quite a popular practice. Just why the special arrangement shown above was used is not clear, however, as the windings are in the same plane

Uses Leaded Glass Window for Lead-in

A CHICAGO radio fan whose receiving set is placed on a buffet close to a row of windows containing leaded glass panels has found that by soldering the aerial wire to the outside of the leaded glass frame, and soldering the connection to the receiving set antenna binding post to the inside of the leaded glass, a perfectly good insulated lead-in wire was secured without having to drill any holes in the sash, or utilize any porcelain tubes or other means of bringing in the aerial connection from the outdoors.

Such an idea will work on almost any kind of leaded glass window where the leaded portions do not connect with a wooden frame, and in many ways the arrangement has been found superior to pasting two sheets of tinfoil on the opposite sides of the glass, as the condenser effect to a certain extent throws the tuning out of adjustment with the latter procedure.

In experimenting with this leaded glass idea, the Chicago fan found that an adjoining casement window could be utilized as a counterpoise with directional effect obtained by swinging the window in and out. The combination of leaded glass, lead-in and counterpoise is something that fans might experiment with to their advantage, preferably during the summer months, when the pneumonia germ is not so prevalent as in the winter.

Contributed by JOHN T. JONES.

In the February Wireless Age Watch For . . .

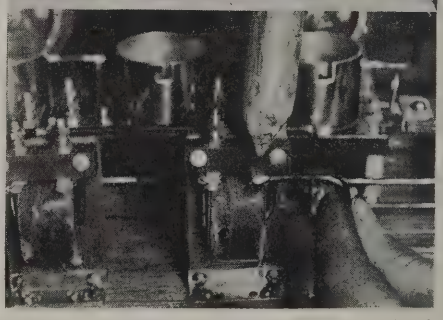
RADIO ENGINEERING, by John R. Meagher. The start of an experimental home-laboratory course in simple and advanced radio design. All easy stuff and lots of real dope.

THE WIRELESS AGE REFLEX. Complete constructional details of what is doubtless the best one-tube set yet developed.

DESIGN OF LOOP ANTENNA, by Ralph Batcher. Reliable data and information on how to design the most efficient loop for all types of receivers.

Soldering

ALTHOUGH soldering is one of the most important points in the construction of a set, many amateurs do not know how to do it properly. We should first make certain that the iron is hot enough; some fans do this by holding the iron a few inches from the face; if the heat can be felt, the iron is



O. K. With an electric iron this is not necessary as they very seldom become too hot but maintain a fairly constant temperature after the initial heating. The iron should be cleaned and tinned; similarly the joint to be soldered should also be cleaned and tinned. Only a small amount of solder need be flowed on the joint. Do not leave an irregularly shaped bunch of solder on the connection; that isn't a good joint. Use clean flux, as much as necessary to make the solder flow—but clean off the excess by rubbing vigorously with a clean cloth—make the joint shine. 50-50 bar solder, a good hot and clean iron and a good flux means success in soldering.

IN The Wireless Age Workshop there aren't any expensive or precision instruments. Only tools that nearly every amateur possesses are used in the construction of Wireless Age sets. The accompanying cut shows the entire outfit, costing about $7.00; if you want to equip a workshop to make a W. A. set, take this picture to the local hardware dealer and have him duplicate the parts.

A Crystal Receiver

Range: about 30 miles
Cost: from $5 to $10

A long distance regenerative receiver may be made with the parts used in the crystal set described on this page. Complete information on how to make the necessary changes will be published in the next issue of THE WIRELESS AGE.—*Look for it!*

A NAVY type loose coupler for a crystal set was the first piece of radio apparatus we ever constructed; it was a monstrous affair. The primary was about one foot long and six inches in diameter wound with miles and miles of fine enameled wire: the secondary was only slightly smaller.

Nearly a month was taken in its construction, but even aching fingers served not to dampen our expectations of wonderful results. For were we not going to hear Arlington time signals, Key West, Panama and even Nauen, Germany? Sure we were, but did we? I guess not! We had a hard time hearing our own New York naval station only twenty miles away! Oh, and what interminable hours we hung over that set—adjusting the coupling, the sliders, and the "cat whisker"—coaxing, cajoling, threatening—but to no avail.

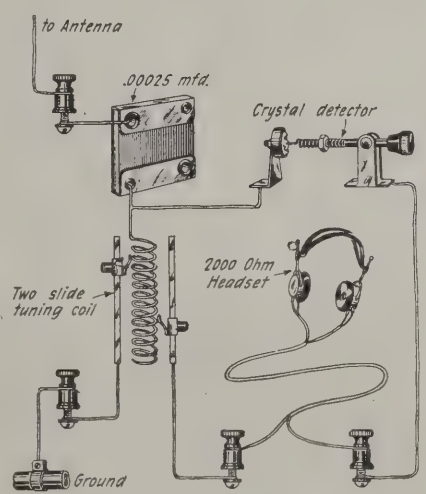
So it was little wonder that the thought crept upon us perhaps this "wonderfully-efficient-long-distance-navy-type-loose-coupler" wasn't all that it was cracked up to be!

So we junked it and made instead a single-slide tuning coil of bell wire wound on a ten-cent rolling pin form, and we had results with it that demonstrated the frightful inefficiency of that bulky loose coupler.

But even at that time, as at present, the single slide tuning coil was looked down upon as a sort of prehistoric and degraded relic. For in the best radio circles loose couplers were the thing for preventing interference and for long distance reception; according to those in the "B.R.C." single slide tuners were out of the question.

But that's the "bunk," because on our single slide tuner we heard more stations and with much greater volume than we had with the loose coupler.

And even with improved couplers we have never surpassed the results that we had with the single slide tuning coil.



MATERIAL

2,000-ohm headset.
1 Crystal detector stand.
4 Binding posts.
1 Winding form, 3"x6".
½ Lb. of number 20 bare copper wire.
2 Sliders.
2 Slider rods, 6" long.
1 Base 7"x10".
200 feet of number 14 aerial wire.

Therefore we would earnestly advise the beginner—the amateur who wants to start from the ground up—to build a good single or double slide crystal receiver rather that the ever so much more complicated loose coupled type.

A circuit hookup of a simple two-slide tuner is shown on this page.

The coil may be wound on a thin cardboard or bakelite form three inches in diameter and six inches long, with number 20 bare copper wire spaced with thin fishing cord. About 100 turns of wire can be wound in the five inches of available space.

The coil, fixed condenser, crystal stand and binding posts may be mounted on a board about 7" x 10" or they may be spread about on a table. Connections should be made with the No. 20 wire in exact accordance with the circuit diagram.

Tuning is very simple: The slider connected to the ground varies the wavelength of the antenna circuit; the other slider adjusts the secondary wavelength. Both sliders may be moved together for rough tuning or "pickup" work and final adjustments may be made with the secondary slider.

The antenna and ground are of much importance: The former may be a two-wire aerial between 100 and 200 feet in length and erected as high as possible above surrounding objects.

The range with a receiver of this type is of course dependent upon many variable factors, but reliable reception of broadcasting stations up to 30 miles may be expected. However, much greater distances have been covered and numerous reports of real DX work of 100 miles and more have been received.—J. R. M.

CONDUCTED BY JOHN R. MEAGHER

A self-addressed stamped envelope will insure a prompt reply to any queries on radio

Negative Grid Voltage

Mr. R. C. Panziger of Chicago, Ill., inquires: "In looking over some text book diagrams of resistance-coupled amplifiers I am struck by what is to me an evidently wrong connection. It is this: They say that in a resistance-coupled amplifier the B battery voltage must be nearly doubled because the coupling resistance reduces the voltage on the plate. This appears reasonable, but then they say that to make the grid negative by 3 volts a 3-volt C or grid battery should be inserted between the grid leak and the negative side of the filament.

"Now the grid leak has a resistance ten times are high as the plate resistance, so why shouldn't the grid battery be of a much higher value in view of the fact that there is so much resistance between it and the grid?"

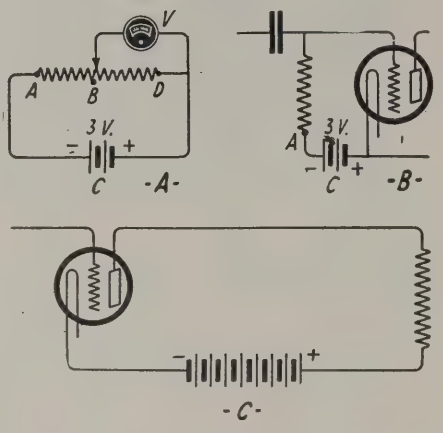
Gosh, Mr. Panziger, you almost found the text books to be wrong—didn't you? But fortunately, they aren't. The explanation may be given in a simple battery circuit.

Take (A) which shows a battery C of 3 volts connected across a resistance. If a voltmeter is connected from the slider to the positive side of the filament as shown and the slider is moved across to (A) the meter will read 3V. If the slider is moved to the midpoint (B) a reading of 1.5 volts will be secured. The percentage of resistance between (D) and the slider to the total resistance is the same as the voltmeter reading to the battery voltage.

Now suppose the slider is at a point near (A) where the value of resistance between the slider and the positive terminal is almost 100 per cent. of the total resistance; then the voltmeter will register almost 3V.

Look now at (B). Here our C battery is connected to a resistance comprising the grid leak and the grid-filament resistance. The latter has an infinitely high value (when the grid is negative) so the percentage of the resistance between the grid and filament to the total resistance (grid-filament resistance plus grid leak resistance) is nearly 100 per cent. Therefore there is a difference of practically 3 volts negative between the negative filament terminal and the grid.

The point which you overlooked and which accounts for your query is the difference in resistance values of the filament-grid path and the filament-plate path. The former is infinitely high (when the grid is negative with respect to the filament) while the latter is comparatively low.



Method of determining negative grid voltage

Best Tube?

Mr. C. Smith of San Francisco, California, asks for information about the "best" tube and which one we would recommend for all-round use.

There really is no tube to which we can point and say that it is superior to all others. But we can state which tubes we prefer for certain purposes.

For instance, as a detector if the proper battery voltages are applied, the UV-200 (C-300) is more "sensitive" than the majority of other types. But the UV-200 requires a storage battery for filament supply whereas the WD-11 and -12 and UV-199 (C-299) tubes may be operated with dry cells and are capable of giving results almost equal to the UV-200.

For radio frequency amplification with fixed semi-tuned (transformer-choke coil-resistance) inter tube coupling the UV-199 usually gives better results—not because it is a better tube, but because of the lower inter-electrodic capacity and consequent lower capacity across the terminals of the coupling device—making for a "broader" adjustment and corresponding amplification over the effective ranges. With tuned transformers or tuned impedance coupling a tube such as the UV-201-A will generally give better results than the UV-199. However, advantage may be taken of the low plate-grid capacity of the UV-199 in tuned transformer-coupled amplifiers by placing more turns on the primaries of the transformers; although the average, for short wave reception, is from 8 to 16 turns we have used about 50 with excellent results and with no difficulty in the control of self oscillation.

For audio frequency amplification we are heartily in favor of the UV-201-A (C-301-A) because it is a splendid amplifier; it is quiet; and it consumes so little filament current.

DX Regenerative Receiver

Mr. Charles J. Fitzgerald of Savannah, Ga., wants "—some dope on a really good long distance one-tube regenerative set for amateur and broadcast reception."

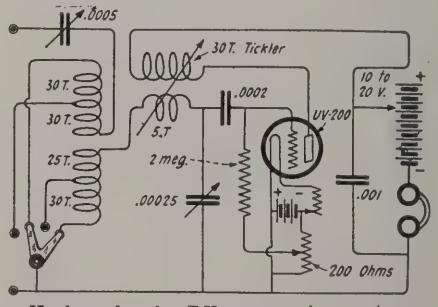
We are printing in these columns a circuit diagram of a very good one-tube regenerative receiver.

No. 28 or 30 double cotton covered wire may be used on all the coils and the winding forms should be very thin hard rubber or bakelite. The primary and all of the secondary, except 5 turns, are wound on a 3-inch tube about 6 inches in length; a space of 1.5" is left between the coils. The tickler of 30 turns and the five-turn grid coupling coil may be wound on a lightly constructed variocoupler form from which all other windings have been removed.

The variable condensers must be of the very highest quality and contact to the rotary plates should be through flexible leads. Verniers are not necessary, but if they are used they should be of the mechanical type.

The filament rheostat should be of the carbon compression type as the UV-200 tube requires a delicate filament adjustment for best results. The grid leak potentiometer is not absolutely necessary; if it is not used the grid leak should be connected to the positive side of the A battery.

The two-lever switch (shown in the diagram) affords a simple and quick method of switching from amateur to broadcasting wavelengths.

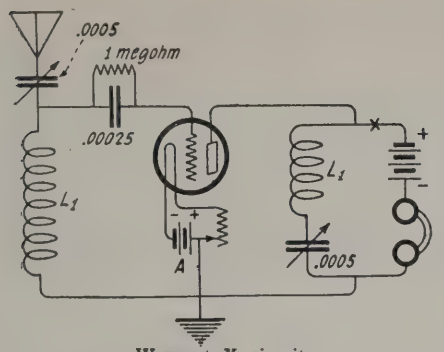


Hook-up for the DX regenerative receiver

Simple X Circuit

"Please publish a diagram and detail of a simple Weagant X circuit," writes Mr. O. T. Brown of Phoenix, Arizona.

The diagram on this page shows the proper connections for a Weagant X circuit receiver. If the filament rheostat is eliminated through use of a fixed resistance, an "Amperite" or the proper filament battery voltage, there will be but two controls; the antenna series condenser for tuning and the plate condenser for regeneration. If the Weagant circuit doesn't oscillate insert a radio frequency choke at the point marked X.



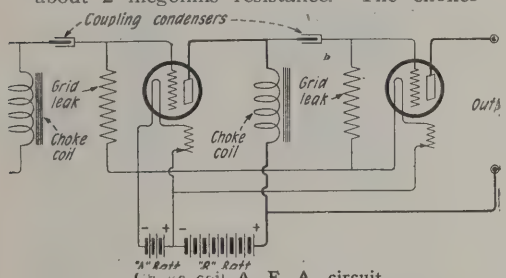
Weagant X circuit

The coils, L_1, may be of any form—single layer, honeycomb, spider web, curkoids, etc. Each should have an inductance of about .25 mh. Suitable coils may be wound on thin 3" forms with 50 turns of No. 30 double cotton covered wire. A small 7 x 10-inch panel will serve to hold the entire equipment.

Choke Coil A. F. A.

Mr. Ralph Elliott of Boston, Mass., writes for "a diagram of a choke coil audio frequency amplifier using two tubes."

A choke-coil a. f. amp. hook-up is shown on this page. The coupling condensers may be of 2 mfd. capacity and the grid leaks of about 2 megohms resistance. The chokes



Choke coil A. F. A. circuit

should have an impedance at speech frequencies equal or greater than the internal impedance of the tube. The secondaries of Ford spark coils have been used quite successfully.

Quality A. F. A.

Mr. R. Wittington of Astoria, L. I., is "—perplexed over the choice of an amplifier. I understand that the transformer-coupled type affords the most amplification per stage, but that considerable distortion is inherent in them. Would you kindly publish details of an amplifier that will give good undistorted amplification?"

A diagram of a "Distortion Free" amplifier is shown on this page. This system will give excellent reproduction and though the amplification per stage is not as great as in a transformer-coupled amplifier, still the quality is vastly superior. One disadvantage of this type is the necessity for a high plate battery voltage. However, if storage B batteries (as described in the December WIRELESS AGE by Mr. J. Brooks) are used this disadvantage will not be a severe drawback.

For further information about the design, construction and operation of resistance-coupled amplifiers we suggest that you read the article by Mr. Ringle in the December WIRELESS AGE.

B Battery Voltage

"What voltage B battery would you recommend for use with all types of amplifying tubes?" writes Mr. B. Slocum of Denver, Colorado.

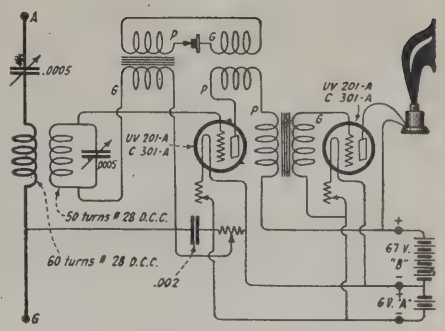
This is a question we settled with ourselves some time ago while using a six-tube receiver and dry cell B batteries with UV-201-A tubes. Usually we used 90 volts consisting of four 22.5-volt blocks. Experiments showed that there was no decided decrease in signal strength when only 67 volts were used. And as our detector plate was operated on 67 volts, we were able to eliminate one battery lead by making the plate voltage of all tubes 67. Furthermore, with this value of plate voltage there was no necessity for special grid batteries. And in addition, replacement of the three blocks is cheaper than four.

We always use separate blocks to make up the complete battery in order that if one cell goes dead, only one block will have to be discarded, whereas if one cell in a unit block of 67 volts is defective the whole battery might have to be "junked."

So we would suggest the use of three blocks of either storage or dry cells.

Reflex Amplifier

Mr. K. Merz of New York writes: "I have tried numerous two-tube reflex hookups but have had very little success with this system. It seems that my reflex receivers just won't percolate. I imagine it is the fault of the circuit, as I have followed them out exactly and have tested all the equipment. I would be most obliged if you will publish a good, reliable hookup for a reflex receiver that will operate a loud speaker with two tubes."



Circuit diagram for reflex amplifier

Surely; we are showing on this page a reliable circuit diagram for a one-tube reflex with an extra stage of audio frequency amplification. A crystal is used for rectification.

If good amplifying tubes, like the UV-201-A (C-301-A) are used with a plate battery of 60 to 90 volts you should obtain satisfactory loud speaker operation.

You can use the material you have or make up the set as follows:

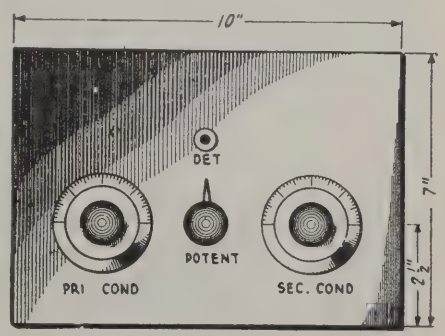
Fixed coupler—3" tube, 1/16" wall and 4" long. Primary, 60 turns of No. 28 or 30 D. C. C. wire. Secondary, 50 turns of No. 28 or 30 D. C. C. wire. Separation of ½" between coils.

Potentiometer—200 to 400 ohms with a .002 mfd. fixed condenser shunted across the slider and negative A battery terminals.

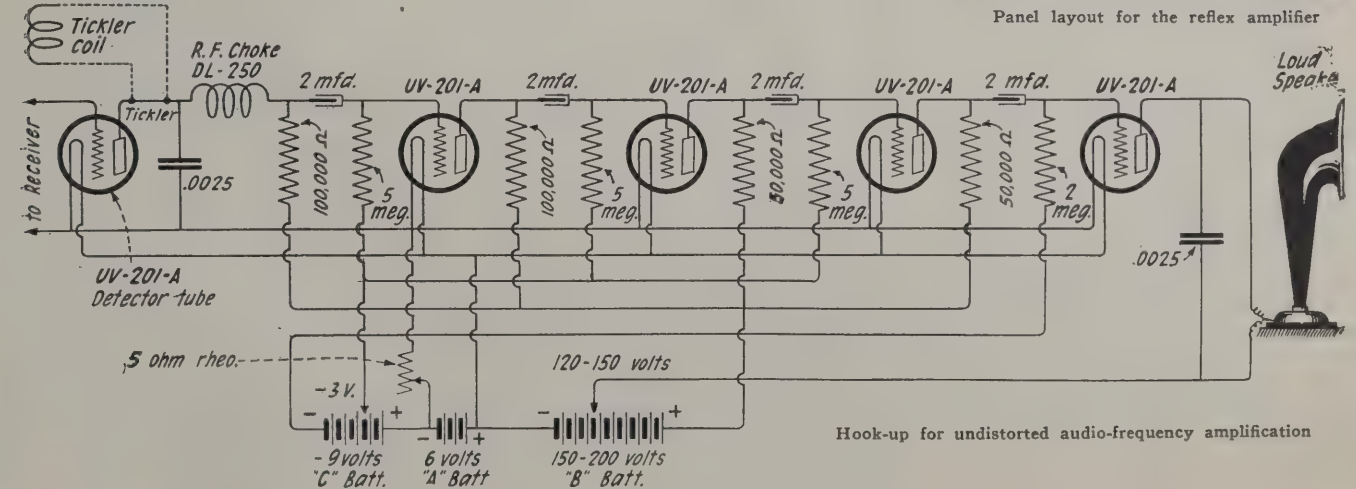
Audio frequency transformers—Both 4 to 1 ratio connected exactly as shown.

Filament controls may be 10-ohm rheostats or "amperites" of the proper type.

A standard 7" x 10" hard rubber or bakelite panel may be used if the parts are arranged as suggested in the layout sketch. The fixed coupler is mounted on the panel above the two variable condensers and the vacuum tubes, transformers, etc., are fastened to the wooden base.



Panel layout for the reflex amplifier



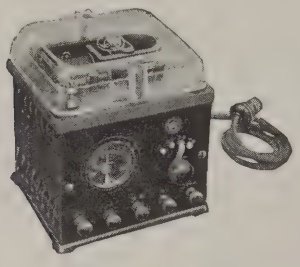
Hook-up for undistorted audio-frequency amplification

NEW APPLIANCES AND DEVICES

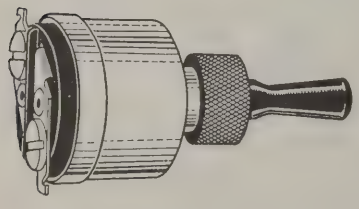
The New Valley Charger

THE Valley Electric Company of St. Louis is now in full production on the new Valley Type ABC Battery Charger, the improved model which the company has put out this year.

The type ABC charger has been designed to charge all radio batteries. It is built on the same principle as the other successful Valley rectifiers, but it is made for use on all types of radio storage batteries, including the 2-volt peanut tube batteries, 6-volt A batteries, and one two, three and four 24-volt B batteries. It has a tap for 12-volt batteries and may be used on 6- or 12-volt automobile batteries.



In order to make this new and complete radio battery charger harmonize with the home radio receiving set, the Valley Company has adopted a bakelite panel for the face of the charger with fittings and other parts in keeping with the use to which the instrument is to be put.



The Bradleyswitch

THE Allen-Bradley Co., Milwaukee, Wisconsin, have added a fourth item to their list of radio products, known as the Bradleyswitch. This is a very compact, completely enclosed, single-pole switch for opening battery circuits. It is mounted by drilling a hole in the radio panel and securing the switch by means of a knurled nut. The switch is operated by pulling or pushing the switch button.

The Bradleyswitch is nickel-plated and the button is polished black, thus conforming with the standard finish used for radio equipment.

Hartman Loop

THE Hartman Loop Aerial is well adapted for use with standard sets. Using a .00025 mfd. variable condenser across the loop, the wave length range will approximate 200-550 meters.

The Hartman Loop is small but highly efficient and directional. A detachable wood base, with a 4-inch moulded dial is provided. All castings are made of aluminum.

The combination of carefully selected wood cross arms, and the arrangement of the windings equalizing the strain, minimizes the possibility of warping.

New Non-Inductance Potentiometer

RADIO fans who are using wire wound potentiometers and have had trouble with inductance in their receiving circuits will be interested in the new non-inductive potentiometer, shown in the accompanying illustration, which has been recently perfected by the Central Radio Laboratories.

The new instrument has a thin resistance element made of pure graphite and is not only non-inductive but also free from "skin effect." This feature of the design eliminates the choke-coil effect found in wire wound potentiometers and also insures the same resistance to radio frequency as to direct current.

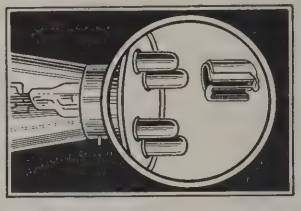
Smooth, noiseless operation is made possible by a circular disc of brass placed between the resistor and the pressure shoe and mounted in such a way that it can be made to engage the resistor at any one of the infinite number of points. As the resistor is not touched by the sliding shoe there can be no wear. The moulded base is provided with a transparent cover which protects the parts from dust and moisture and allows a clear view of the interior.

Type No. 110 has a resistance of 400 ohms which is the best value for accurate adjustment of plate potential and grid bias in vacuum tubes. A 2,000-ohm type, No. 111 is also made for special applications.

Radeco Safety Fuse

THIS device is a fuse which fits over one of the filament terminals of a vacuum tube and absolutely prevents "blowing out" from any excess current such as "B" battery, etc.

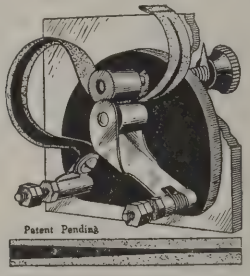
A fuse of this sort is a necessary article as we all know that many tubes are needlessly destroyed by the accidental crossing of wires.



The fuse is attached in an instant and does not interfere with the efficiency of the set or the fitting of the tube in the socket.

Monroe Ribbon Grid Leak

A RATHER novel panel mounting variable grid leak has been developed by the Monroe Manufacturing Co. of Chicago.



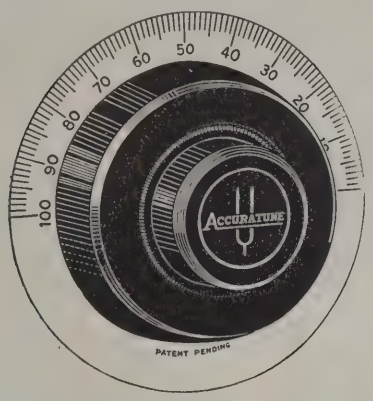
The resistance element is arranged on a flexible ribbon which passes through rollers —somewhat on the style of a clothes wringer. By manipulating a knob connected to one roller the length of ribbon between contacts may be varied. Thus the value of resistance may be increased or decreased at will.

This variable grid leak will prove of value in the operation of critical vacuum tube detectors, in the Flewelling circuit, in resistance coupled amplifiers and as distortion smoothers when connected across the secondaries of audio frequency transformers in an audio frequency amplifier.

The Accuratune

THE Accuratune is an actual micrometer control. For coarse adjustment the larger knob is used like any ordinary dial. The smaller knob operates the vernier mechanism for fine tuning. By rotating the dial from 0° to 100° by means of the vernier knob you can pick up station after station.

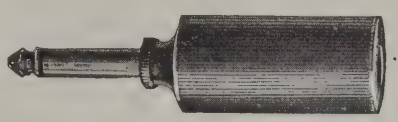
The Accuratune is made of genuine bakelite (highly polished, black or brown) with beautiful silvered dial and neatly engraved graduations. Fits either 3/16 or ¼-inch instrument shafts. Dial 4-inch diameter.



A Particular Plug for Particular Radio People

IN order to meet the requirements of that group of radio amateurs and radio broadcast listeners who insist on something better than the usual run of radio equipment, there has been developed a special plug which is shown in the accompanying illustration.

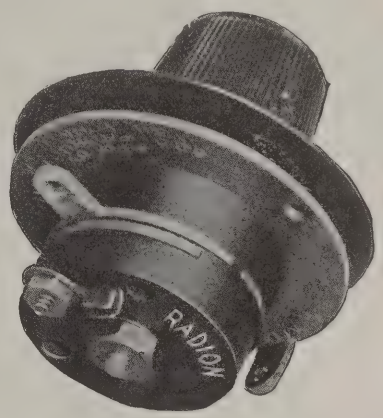
The Pacent 100 Duoplug accommodates two pairs of phones in parallel. No tools are required in making connections. The special type thumb nut connectors may be tightened with fingers, the nut being slotted so that with a dime or other thin coin a permanent, secure connection can be made. The special toggle structure of the connector screw, which is an exclusive Pacent feature, is important in that it permits two different sized cord tips to be connected at the same



time. The connectors also accommodate stranded or solid conductors, spade tips or practically any other type of terminal. Grooving on inside surface of connectors prevents connections from becoming loose. Bakelite insulation piece between the connections obviates any possibility of short circuiting and provides a means of attaching the cord. The engraving on this strip indicates the polarity of the connectors. The handle of the plug is of Bakelite, finely knurled, making for neat appearance and for a positive grip. Exposed metal parts are heavily nickeled. No live metal parts are exposed. No parts can become lost.

The Amsco Compensating Condenser

THIS unique device serves to eliminate the necessity of a potentiometer in radio frequency amplifying circuits, whether of the tuned, untuned or resistance coupled type. And because variation of its capacity is so readily accomplished the control is positive and effective.



The manufacturers of the Amsco condenser have used Radion insulation in the compensator in an endeavor to keep both the surface leakage and dielectric losses at a minimum.

State College Receives Gift of Radio Plant

THROUGH the efforts of Dean Goddard, the New Mexico College of Agriculture and Mechanic Arts is the recipient of the gift of a new radio station. This will include the equipment for constructing a 100-watt transmitter and the building to house it. The station will be utilized for experimental purposes and amateur relay work under the government license of 5XD. It will be separate and entirely distinct from the present radio house and its equipment, which will then be used solely for broadcasting service under its present call letters of KOB.

Plans for the new radio house call for a frame building 15x24 feet, with concrete floor. An operating room will occupy the east end of the building, while a club room for the College Radio Club will be at the west end. The center will contain a workshop and closets for the storage of miscellaneous equipment and batteries.

A site east of the Engineering Department's Forge Shop and south of the Commercial Building has been selected. This site gives plenty of open space about the building, where a new aerial of the T-cage type can be easily erected. It is planned to support the new aerial from two 60-foot A frame towers, spaced 125 feet apart. A counterpoise system of 20 wires is planned. These wires will radiate from the roof of the building in all directions to steel post supports at their outer ends.

The transmitter planned is of the reversed feed back type, using two 50-watt radiotron tubes for oscillators. The plate current will be supplied by a kenotron rectifier and filter system. The materials for this have already been purchased, and the set will be constructed by the Radio Club members from designs furnished by Dean Goddard.

When completed, this new station will give the College radio experimental facilities, which, combined with its present extensive equipment, will be unsurpassed by any college in the west, if by any in the United States. The work of the present station has gained a national reputation for the college in this branch of engineering. A number of students are now attending this institution because of the exceptional facilities offered along these lines. With the wide spread of interest in and use of radio as a means of communication, it is anticipated that the industry will require a large number of electrical engineers especially trained in this branch. Indeed, at the present time, the manufacturers of radio equipment cannot supply the demand, and much damage has resulted from the flooding of the market with cheap and worthless apparatus put out by incompetent and get-rich-quick dealers.

Radio Has Great Speed

IF you are 186 miles from a broadcasting station, when you listen in you hear each sound one thousandth of a second after it is produced in the broadcasting studio. This is because radio waves travel at the rate of 186,000 miles a second, so fast as to be instantaneous over all normal broadcasting ranges. If you were in a studio and with one ear heard a note struck on the piano, and at the other ear could hear the same note transmitted a thousand miles by radio, your ears would be unable to distinguish between the two. They would sound like a single note.

Speech Amplifier

(*Continued from page 56*)

here that the function that each of the switches A, B, C, D, E, performs is in the course of changing from phone to CW and ICW and will be explained in detail later.

Figure 2 is a schematic diagram of the oscillatory circuit used by the writer in connection with the speech amplifier just described, and since it worked so well I think I will describe it here although some of you may be already familiar with this type of circuit. In general, it is a closed oscillatory circuit coupled loosely to the antenna system, and the inherent advantage of this kind of a circuit is that the frequency of the emitted wave is dependent upon the constants of the closed oscillatory circuit and the change in capacity that the antenna undergoes when swinging in the wind will not change the frequency of the emitted wave; it will simply change the efficiency of transformation of energy from the closed oscillatory or tank circuit to the open oscillatory or antenna circuit as the antenna system swings in and out of tune with the tank circuit. There is of course only a slight capacity change during the swinging of an antenna so the relative drop in radiated energy due to this effect will be small. This type of circuit will radiate a constant frequency regardless of changes in the constants in the antenna system due to climatic conditions. There is one slight disadvantage to a circuit of this type because there is a slight loss of energy during the transfer from the tank circuit to the antenna circuit. Obviously it would be better if we could have a directly coupled type of circuit that would emit a constant frequency as we would be able to get more energy into the antenna. There is a circuit under development that will do just this very thing and later on I may write about this new circuit in detail.

The modulator and oscillator tubes used in this circuit are the same and may be either of the following type of tubes: UV-203, 50-watt tubes; UV-204, 250-watt tubes; UV-206, 1. KW. tubes. The speech amplifier will supply enough energy for the grid of the modulator tube no matter which of the foregoing tubes mentioned are used. In this case, due to the popularity of 50-watt tubes, the circuit has been adapted to the use of these tubes. In the case of the writer the UV-206, 1. KW. type of tube was used and the results were very gratifying.

Power Transformer

The power transformer in this case is the UP-1016 which is rated at 750 watts output and is capable of delivering the plate supply for the two UV-217 kenotrons and the filament supply for the kenotrons and the UV-203 radiotrons used in this circuit.

Rectifier

We will use two UV-217 kenotrons in this case for full wave rectification and will control their filaments by means of a PT-537 filament rheostat in series with the secondary winding that supplies these filaments. It will be necessary to connect this rheostat in the circuit with its resistance coils in parallel in order to handle the current for the two filaments. The A.C. supply to the plates of these tubes from the secondary winding of the power transformer is 1500 volts each and we can expect to get a rectified voltage of 66 per cent. of the A.C. or 1000 volts.

Filters

UC-490 filter condensers are used here instead of UC-488 as in the case of the speech amplifier because they will stand 1750 volts against 750 volts for the latter.

The 1000-cycle trap circuit in this case is made up of a UP-1654 filter reactor in parallel with a UC-1015, .0005 mfd. condenser. The inductance of the reactor is 50 henries or 50,000 milli-henries and therefore a UC-1015 condenser of .0005 mfd. capacity is necessary in parallel with it to tune to 300,000 meters (1000 cycles).

The radio frequency choke used here is a UL-1655 which has an inductance of 3 mh.

We now arrive at the modulator tube with a plate supply that is very nearly D.C.

Modulator

This tube is a UV-203, 50-watter, and its filament is supplied by the radiotron winding on the power transformer and is controlled by a PT-537 filament rheostat. The grid of this tube is supplied with excitation from the output of the speech amplifier—the point marked "to grid of modulator" on the diagram.

Oscillator

Another UV-203, 50-watter is used here as an oscillator and is connected to the plate supply through the 6 mh. choke composed of two UL-1655 radio frequency chokes in series.

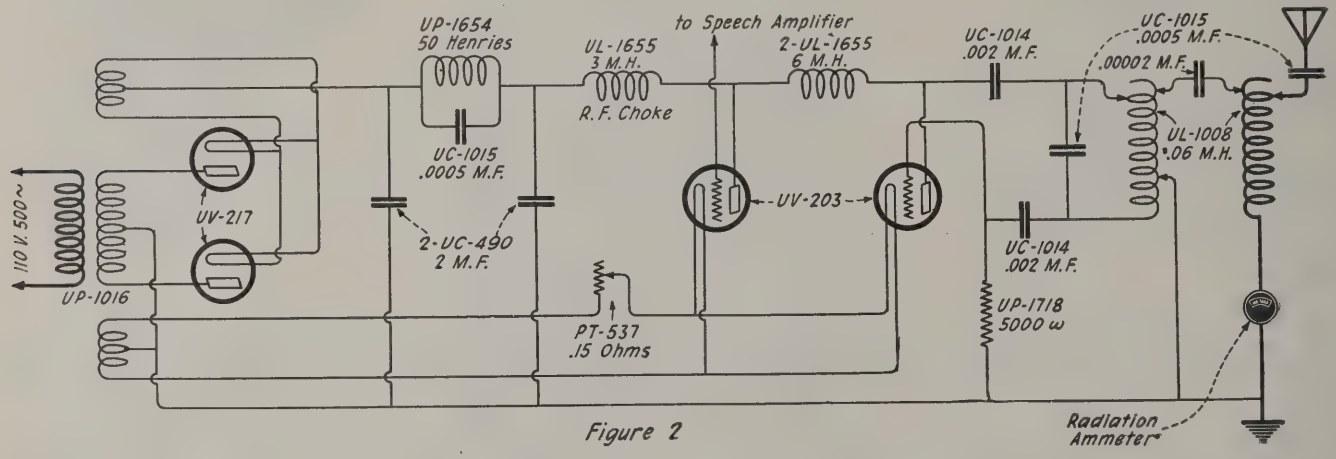


Figure 2

This diagram represents the hook-up of the oscillator

The filament is connected to the same winding of the power transformer and controlled by the same rheostat as the modulator tube.

Oscillatory Circuit

The constants of this circuit depend upon the wave length it is desired to radiate and assuming an amateur wave length around 200 meters, the constants of the circuit would be as follows: The tank inductance should be a UL-1008 oscillation transformer which has an inductance of .06 mh. and the capacity shunted across this coil should be a UC-1015 which has taps for three different capacities, namely, .0003, .0004, .0005 mfd. The plate is connected to this coil through a UC-1014, .002 mfd. blocking condenser. The grid is connected to the other end of this coil through another UC-1014, .002 mfd. blocking condenser. The grid is also connected to ground through a UP-1718, 5000-ohm grid leak. The ground tap is connected on the coil at a point about 1/3

(*Continued on page 74*)

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

Radio has moved from the laboratory and amateur's work-table out into the refined surroundings of the family living room. In keeping with this new companionship we offer this reliable, long-lived Eveready "B" Battery, in an attractive, new metal case, worthy to stand beside the rich cabinets of fine radio sets.

Eveready "B", 22½ volts, No. 766 with Six Fahnestock Spring Clip Connectors.

When Radio called, Eveready was ready

TWENTY-ONE years ago, when wireless telegraphy had its first birthday, National Carbon Company's dry cell batteries were nine years old. Even then its batteries were world famous as convenient, economical and efficient sources of electric energy.

With the introduction of broadcasting, radio leaped into universal service. Radio engineers used Eveready Batteries as their standard in designing tubes and receiving sets. Eveready engineers, backed by the most complete research and testing laboratories known to the industry, worked with them to discover how the known dry cell could be improved for radio work.

The fruit of these efforts is the Eveready family of radio batteries, conspicuous for vitality and endurance—the right battery by test and proof for every radio use.

To be certain of battery satisfaction, insist on Eveready Radio Batteries—they last longer. All reliable radio dealers sell them.

Informative and money-saving booklets on Radio Batteries sent free on request.

NATIONAL CARBON COMPANY, INC., New York, N. Y.

Headquarters for Radio Battery Information

If you have any battery problem, write to RADIO DIVISION, NATIONAL CARBON COMPANY, INC. 198 Orton Street, Long Island City, N. Y.

Eveready 6-volt Storage Battery

Eveready Radio "A" Dry Cell
Specially manufactured for use with low amperage tubes

No. 764
The Space Saver
Vertical
22½-volt
"B" Battery

No. 767
"B" Battery, 45 volts
Variable taps
Fahnestock Clips

Eveready Three
or "C" Battery
Clarifies tone and increases "B" Battery life

EVEREADY
Radio Batteries
—they last longer

INDUSTRIAL INKLINGS

THE National Carbon Co., in promoting the idea of radio in the home, employs a happy combination in their advertising—romance and art.

Home and family brought into contact with the heart of the world through radio has a romantic touch in, "The air is full of things you shouldn't miss."

Linking radio and fireside with the cosmos has been admirably accomplished by the artist in his composition. The result should be suggestive to other advertisers.

THE Burgess Battery Co., Madison, Wis., publishes a pamphlet containing an index of broadcasting stations, forms on which the stations heard may be recorded, maps illustrating the standard time divisions, a chart of comparative times in the principal cities, besides some general information on dry cell batteries in radio.

A COMBINATION catalogue and instruction booklet is published by Herbert H. Frost, Inc., Chicago, Ill. It contains several unique features desirable to radio fans.

THE Atlantic Radio Co., Boston, Mass., designed a novel window display for stimulating holiday sales, pushing the slogan, "Give him a new set of tubes for Christmas."

A large cone, supporting successive types, illustrated the progress made in the development of vacuum tubes.

MR. HAYNES of Haynes-Griffin Radio Service Inc., New York City, has introduced a feature that marks another milestone in gaining public confidence.

Every afternoon at 4:30 he gives an informal talk in the store on Super-Heterodyne circuits, and other current topics, to all who wish to attend. Questions from the audience are encouraged.

W. B. JOYCE, chairman of the National Surety Company, has acquired a substantial interest in the Dubilier Condenser & Radio Corporation and has been elected a member of the board of directors.

THE Willard Storage Battery Company has a monthly publication, "The Connector," issued in the interests of a still better Willard Service Organization.

Their November number has some lively window display stimulators.

BURT'S SUPPLY AGENCY, Atlantic City, N. J., went out after the business on an "installation service" basis. A truck carrying a ladder is featured in Mr. Burt's advertising with the slogan, "This is the truck that will install your Christmas Radiolas free of charge."

THE Radio Bible Service Bureau, Cincinnati, Ohio, is organized to give the world daily, "a message from the Word of God by radio broadcasting."

THE appointment of E. W. Martin as Chicago District Manager has just been announced by the Valley Electric Company, St. Louis, manufacturers of Valley Radio Battery Chargers and other electrical products.

Mr. Martin comes to the Valley organization from the Westinghouse Electric and Manufacturing Company with which he has been associated for a number of years in various capacities.

The appointment of C. L. Krentz in the sales department of the Chicago Office is also announced by the Valley Electric Company.

To the Philadelphia Show by Airplane

MR. C. D. TUSKA, president of the C. D. Tuska Company, received a telephone S O S from his Philadelphia representative, Mr. L. B. Underwood, that the Superdynes had not arrived for the radio show which opened that day, November 13. Mr. P. K. Spencer, factory manager, loaded several in his private airplane and with Mr. Tuska reached Philadelphia by noon, a flight of less than two hours.

New Magnavox Catalogue for the Radio User

THERE has just been published by the Magnavox Company a very useful and attractive catalogue for the information of radio users.

In addition to very adequate illustrations and descriptions of the Magnavox Radio line, there is also an entire section devoted to correct hookups and general information, which even the very experienced radio enthusiast will find helpful.

There are also pages devoted to illustrating and explaining the fundamental principle involved in the Magnavox electro-dynamic and also the Magnavox semi-dynamic types of reproducer, the latter type having been evolved in order to meet the requirements of dry battery receiving sets.

Copies of this Magnavox radio catalogue will be sent on request by the Magnavox Company, Oakland, Calif., or 370 Seventh Avenue, New York City; and are also obtainable from radio dealers who handle the Magnavox line.

Pushing Small Parts

IN one of the best radio trade catalogues we have yet seen, the H. H. Eby Manufacturing Company "tell the world" about the famous Eby binding posts.

The first text page contains six points of business policy worked out in a most clever and sincere manner. We wish every manufacturer and dealer would cut out that page, hang it over his desk and believe in it.

After this bit of super-salesmanship the different types of Eby binding posts, each with its distinguishing name, are described in detail; splendid photographs helping the reader to appreciate the numerous mechanical and electrical features of superiority. Then, having told why Eby posts are good, they back it up with a two-page half-tone which speaks for itself insofar as it pictures almost 57 varieties of manufactured radio receivers and instruments using Eby posts. Nothing could be more convincing!

The end of the catalogue is devoted to subjects most dear to the dealer's heart—national advertising to make Eby post move fast and attractive, snappy counter display to catch the eye and spare cash of the customer.

To really appreciate the 15th catalogue of the Eby Manufacturing Co., one has only to read it. We would like to see more of its kind.

America Exports Sets to 41 Countries

AMERICAN manufacturers of radio apparatus are leading the world in exports, the past eight months' total being valued at $2,200,000, according to Department of Commerce figures. In August, Argentina led other countries in the purchase of American-made radio equipment; our exports going there amounted to $99,059. Uruguay stood second with $40,984 worth of apparatus, while Canada imported $27,648 worth of American equipment. The total American exports in August amounted to $307,127, going to 41 countries.

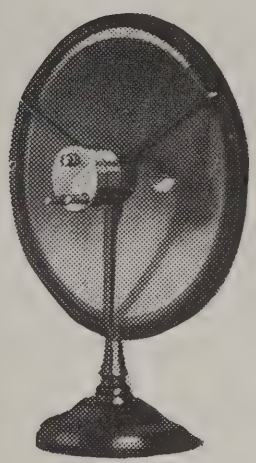
New 1924 Model

Pathé

REG. U.S. PAT. OFF.

LOUD SPEAKER

Mahogany Finish



PRICE Now

$17.50

(West of Mississippi $19.00)

See It Today

Step in your dealer's store—he will gladly give you a demonstration without obligation. See this wonderful new value, placed on the market now for the first time. You will realize the outstanding superiority of the new Pathé Loud Speaker. Notice its beautiful Mahogany finish and its ability to reproduce long distance signals clearly. With the new low price it is the best buy on the market.

Free Pamphlets

Write now for free pamphlets on the Pathé Loud Speaker, Pathé Variometer, Pathé Variocoupler, Pathé Dials and the new Curtantenna.

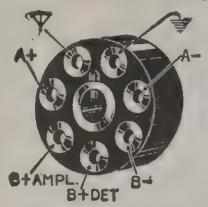
Jobbers and dealers write for new special Proposition.

Pathé Phonograph & Radio Corp.

20 GRAND AVENUE BROOKLYN, N. Y.

Western Sales Office, 533 Wabash Ave. Chicago, Ill.

Face of Panel Mounting



Showing Contacts

Rainbow Multi-Plug and (8 ft.) Cable

Either panel or binding post mounting.
Does away with unsightly wires.
Leaves set free from live wires when not in use.
Several binding post ends can be connected to different sets—using one plug and cable connected to batteries, etc.
Ideal for dealers—and experimenters.
Prices Multi-Plug & Cable Panel Mounting type, $4.00. Binding Post type, complete, $5.00.

Write for illustrated folder of Howard B. Jones Radio Products.

HOWARD B. JONES, 612 S. Canal Street, Chicago, Ill.

SOLID COMFORT Comes With The Use Of The

TRADE MARK
AUDIOPHONE
REG. U. S. PAT. OFFICE

because nothing is lost from the original broadcasting.

Not only is it easily possible to distinguish the words of the speaker, but also the minute graduations in pitch, timbre and quality of overtones which distinguish individual voices.

The Audiophone is complete and self-contained—needs no separate battery or other accessories—goes to you ready for use on connecting to your receiving set. It will prove a source of lasting pride and pleasure.

Audiophone Sr. .....Price $32.50
Audiophone Jr. .....Price $22.50

Bristol One Stage Power Amplifier

If greater volume is desired, over what you already obtain, use the Bristol One Stage Power Amplifier. No C Battery required.

Price $25.00

THE BRISTOL COMPANY
Waterbury, Conn.

Please send me without cost or obligation to myself, Bulletins Nos. 3006 and 3011-V on Bristol Audiophone and One Stage Power Amplifier.

Name .....

Street and No. .....

City.....State.....

The Personality of a Broadcasting Station

(*Continued from page* 38)

a long time now, almost every night. An infinite variety of entertainment has come over the "radio" and many evenings I have stayed home to listen to the program.

My distant station has never failed me. At the touch of the switch, it was there, and I enjoyed the music provided for the evening. But in the year and a half that I have been listening in, how many times have I complimented the station, how many times have I told of my appreciation for the work of the invisible, but real artists? Well, I remember writing once, a short letter relating the joy which followed the reception of a fine concert, one lonely evening last winter. Only once?

Surely I must have told the station how much I liked the quartet selections which I heard in the early part of the year, and the instrumental music which pleased me particularly some time later on in the season. Did I forget to write the humorist who gave me a full evening's entertainment only last May? Of course, I am not speaking for little Johnny, who could say a lot for the bedtimes tales, nor for Jane, who is quite grown up, and who likes the dance music. But I do feel a sense of guilt, and I am anxious to right myself with the station, whose daily programs have relieved me from much of the day's weariness.

So, as soon as I have finished this, I will begin a real letter of thanks to my favorite station. Perhaps my favorite station is yours also. It will appreciate a word from all of us.

The Navy's Radio Net

(*Continued from page* 33)

accurate astronomical observations are impossible. The ship sends a radio call to one or more of the navy stations, the request is relayed to the compass station, and the position of the vessel within one-tenth of a degree is immediately dispatched to the ship.

More than 5,000 bearings a month are furnished to merchant ships by the department's compass stations, the system last year being the means of preventing fifteen merchant vessels from going aground. The great trans-Atlantic liners invariably use the service when approaching port in inclement weather. The radio beacon, a more recent development, whereby the radio compass is on board the ship, enables mariners to determine their own position by radio, and to steer a straight course to safe anchorage. The compass service is of particular value in so-called fogbound ports such as New York, where preventing de-

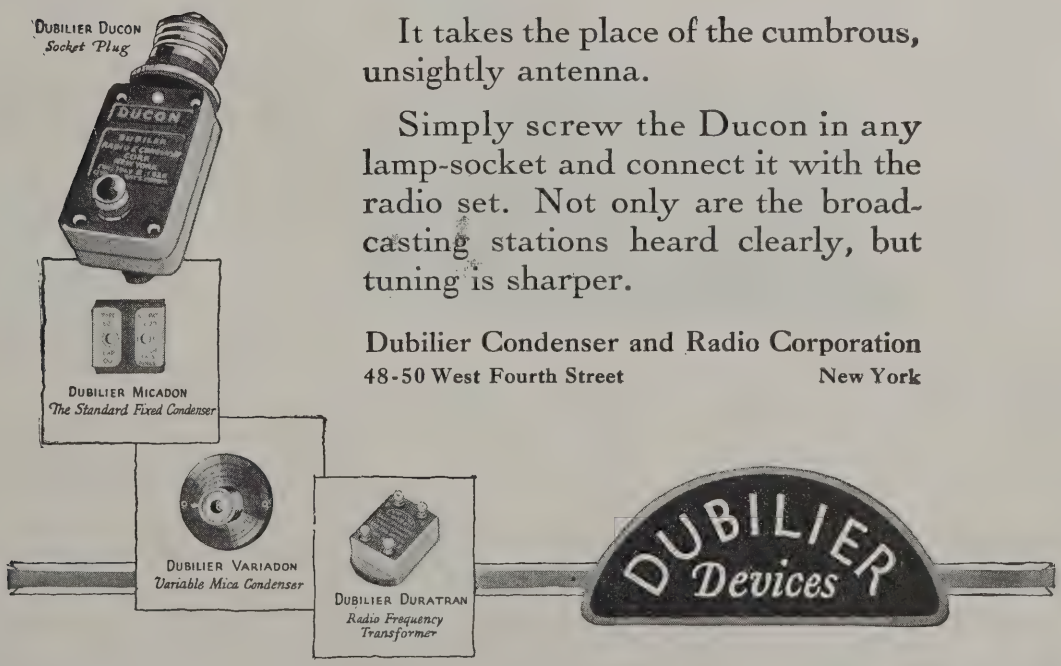
So practical—so convenient

The Dubilier Ducon is the standard socket-plug.

It takes the place of the cumbrous, unsightly antenna.

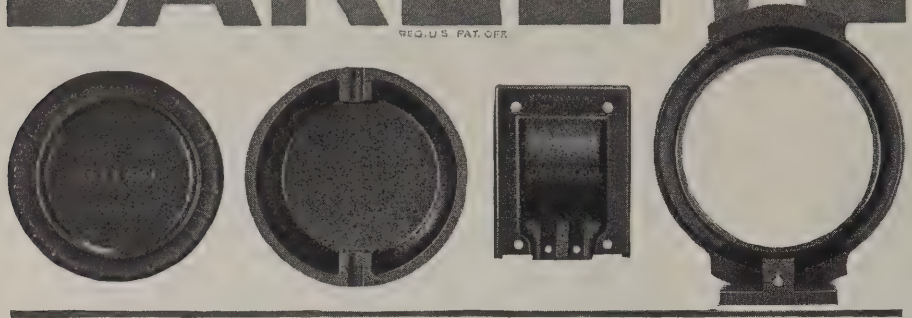
Simply screw the Ducon in any lamp-socket and connect it with the radio set. Not only are the broadcasting stations heard clearly, but tuning is sharper.

Dubilier Condenser and Radio Corporation
48-50 West Fourth Street **New York**



BAKELITE

REG. U.S. PAT. OFF.



Paragon *and* Bakelite

The pleasure and satisfaction that the Paragon Receiver brings to the family circle is appreciably increased through the use of Bakelite.

Bakelite possesses a combination of properties not found in other materials, which makes it peculiarly suitable for this service. Its excellent electric properties provide complete insulation that remains unimpaired under all atmospheric conditions.

Because of its high temperature resistance and non-absorbent properties, Bakelite performs equally well in all climates.

Its great mechanical strength, permanent beauty of finish and color enhances the value of any Radio Equipment in which it is used.

The Adams-Morgan Company chose Bakelite because of these desirable qualities and, for the same reason, leading Radio Manufacturers have adopted Bakelite as standard insulation for the manufacture of parts and complete units.

Send us your name and address and we will mail you a copy of our Radio Booklet A.

BAKELITE CORPORATION
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Chicago Office: 636 West 22nd Street

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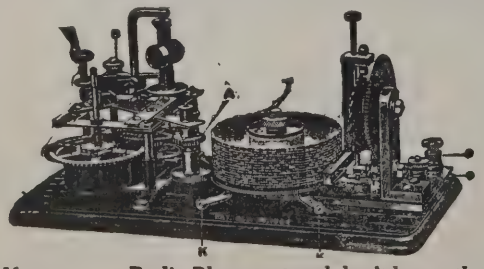
THE MATERIAL OF A THOUSAND USES

Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"



THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. **THE OMNIGRAPH** is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. **THE OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses **THE OMNIGRAPH** to test all applicants appiying for a Radio license. **THE OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models, $14 to $30. DO IT TODAY.

THE OMNIGRAPH MFG. CO.
16B Hudson St. New York City

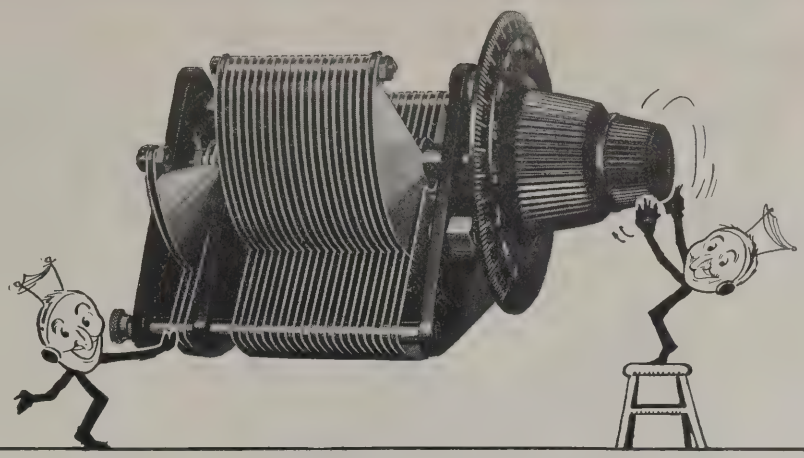
If you own a Radio Phone set and don't know the Code—you are missing most of the fun

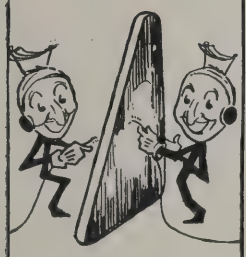
lays in landing cargoes means in the course of a year millions of dollars to American commercial interests.

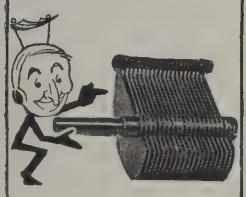
The Federal Poulsen arc, varying in sizes from 100 to 500 KW., is the type of transmitter in general use by the high power navy stations. Originally all stations used spark transmitters, but the continuous wave in the form of an arc was later standardized. With the development of the radiophone the navy was urged to replace the arc sets with alternators on account of the objectionable "mush," harmonics and compensation wave inherent with all arc transmitters, but subsequent experiments to overcome interference proved successful and it is expected that the arc will resume its position as a satisfactory single wave continuous wave transmitter. For low power stations the spark set is expected eventually to be replaced by the continuous wave or interrupted continuous wave, inasmuch as the spark uses too wide a band. The navy has developed an attachment to spark sets in which tubes can be used to give a satisfactory wave, thereby making it possible to remove the spark interference at much less cost than if complete new tube transmitters were installed.

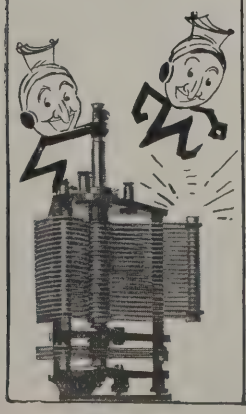
Important contributions to radio art have come out of the navy's radio research laboratories. Much of this work is done in co-operation with the Bureau of Standards and with commercial radio equipment manufacturers. The list of achievements includes, in general, improvements in spark and C.W. transmitters, development of steel and telescope antennas, vacuum tubes, receiving apparatus, radio mechanical relays, high speed transmitting and recording systems, depth sounding and submarine sound signal devices, and aviation radio. Duplex operation has been installed in each navy district whereby several transmitters are used in the sending station and messages are received by remote control. The Arlington station has six transmitters that operate simultaneously.

Central headquarters for the complete system are at Washington where incoming and outgoing messages for all stations are coded and decoded. The central office operates the Arlington, Annapolis and Sayville stations by distant control, the business for all other stations being handled from Washington either by leased land lines or radio relays. Based on commercial rates the system handled for the navy last year nearly $3,000,000 worth of business, and for other departments including the Department of Agriculture, Commerce and State over $1,000,000. Receipts from commercial work were approximately $300,000.









"Some Condenser" says the "Radio Bug"

Makes your receiving set respond to every broadcasting station operating.

The size of the Kellogg Condenser and dial gives easy, accurate tuning. The vernier makes unusually sharp tuning a simple matter.

The end plates are of the best radio insulation in use today—Bakelite. The Kellogg accurately built dial is also of Bakelite, which retains its handsome appearance indefinitely. Its heavy reinforced construction and beauty of design add to the appearance of any set.

The rotor plates are properly spaced and bolted together, making it impossible for them to make contact with the stator plates.

Large bearing surfaces assure smooth, even rotation of the rotor plates and reduce wear to a minimum.

The high class workmanship, with the fine materials used in Kellogg Variable Condensers place them in a class by themselves.

The relations of the capacities is such that as great a flexibility as desired in any set may be maintained by the use of the various models.

The resistance to alternating currents at the average wave length is low thus assuring full use of all current intercepted by the antenna.

The Kellogg variable condenser is a precision instrument built in size, proportion and ratio for use as a decremeter or wave meter, as well as for control of capacity in the radio broadcasting and receiving sets. This makes it of far greater value to the amateur as well as the laboratory expert.

Kellogg Variable Condensers are made in the following styles:

Code No.	Zero Cap.	Max. Cap.	Ratio	Price
601-11 plate Vernier	.000120	.000262	2.1:1	
with vernier All Plates	.000120	.000600	5 :1	$6.75
602-11 plate	.000045	.000396	2.8:1	4.50
603-23 plate Vernier	.000071	.000210	3 :1	
with vernier All Plates	.000071	.000990	14 :1	7.75
604-23 plate	.000071	.000885	12.6:1	5.50
605-43 plate Vernier	.000102	.000250	2.4:1	
with vernier All Plates	.000102	.001800	17.6:1	8.75
606-43 plate	.000082	.001690	20.7:1	6.50

Have your dealer furnish you with Kellogg radio equipment and know you have the best.

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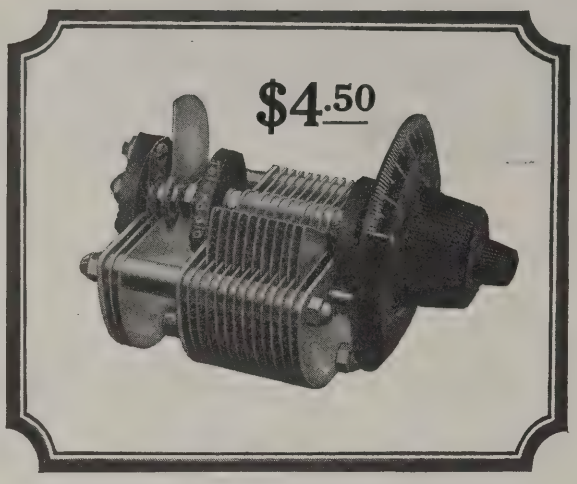
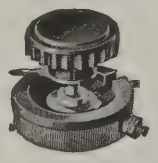
Teleradio



Continuous Satisfaction



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Is reversible and can be mounted on either panel or base. Double brass bearing on spindle insures smooth action and prevents looseness. Contact arm is phosphor bronze. Will carry 1½ amperes without heating.

Price (6 or 30 ohm), $1

The expectations of the radio enthusiast who is endeavoring to get sharp tuning in his set, are fulfilled by the continuous satisfaction of the Teleradio Vernier Condenser.

His joy in finding accuracy and dependability in this instrument reflects the efforts of the manufacturer to fully please the owners of Teleradio products.

With extra heavy polished hard aluminum plates that will not warp, a special locking feature preventing short circuiting of vernier and providing permanent and perfect contact, an accurate and constant capacity, and with rigid construction throughout, there is positive assurance of continuous satisfaction from this precision instrument.

Guaranteed electrically and mechanically.

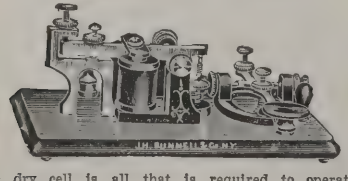
TELERADIO ENGINEERING CORP.
488 Broome Street New York City

VERNIER CONDENSERS, 23 plate, $4.50; 43 plate, $5.50; VARIABLE CONDENSERS: 3 plate, $2.00; 11 plate, $2.50; 23 plate, $3.00; 43 plate, $4.00. HEAD PHONES: 2000 ohm, $5.50; 2200 ohm, $6.00; 3000 ohm, $7.00. LIGHTNING ARRESTER, $1.00.

TELERADIO PRODUCTS

TELEGRAPH INSTRUMENTS

Dandy Morse Learner's Outfit



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Endorsed by Thousands of Satisfied Users.
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RUSONITE CATWHISKER, Price.. 25¢
Permanent. Will Not Oxidize.

RUSONITE REFLEX CRYSTAL
Manufactured Expressly for Reflex Circuits.
Will Stand Up Under Heavy Plate Voltage
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According to Commander S. C. Hooper of the Washington Headquarters, "radio changes the fleet from an unwieldy mass of ships, scouts and aircraft to a perfectly controlled combination of units, each fully informed and directed in order to perform its function at maximum efficiency and at the proper instant. The radio system failing, the value of information and the effective execution of plans of the Commander-in-Chief are destroyed. The apparatus, though complicated, must never fail. It must be compact for easy manipulation, selective for working through interference and of unvarying wave length so that communications will not interfere with one another. No expense must be spared in providing necessary facilities."

Radio Frequency Amplification

(*Continued from page* 54)

signal strength is the ideal condition of tuning which should be striven for, but at the same time if we do so adjust the receiver as to throw it into oscillating condition the results will not be as serious in the production of external interference as it would be if we did not use any radio frequency amplification.

It must be remembered that the one who is using this receiver, or in fact, any receiver that is made, should not be disappointed if the receiver does not give its best results the first time it is used, because it may not necessarily be the fault of the receiver, and in fact, it very seldom is the receiver's fault. The first thing that the broadcast listener seems to think after he sits down at his receiver and it fails to function in what he considers to be a proper manner is that there is some trouble with the receiver. With a home-made affair it is quite posible that the trouble is in the receiver, but with an outfit constructed by a reliable manufacturer this is very seldom the case. The usual trouble lies in the lack of knowledge of the proper manner in which to operate the receiver. For example, let us look at some parallel cases in other mechanical lines. How does an autoist learn to successfully operate his automobile? It most certainly is not by merely learning how to shift gears and how to operate the self-starter. It is only after months of experience with his automobile that he is immediately able to tell what is the trouble if there is some slight sound coming from its interior which he has never heard before. In other words it is experience which enables him to run his car with any degree of success. How is it that the railway engineer

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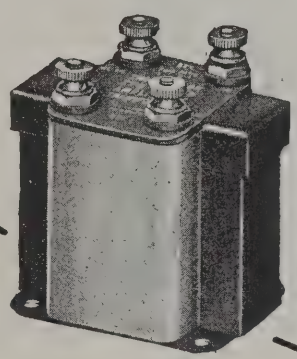
The Royalty *of Radio*

The Colin B. Kennedy Co., internationally renowned for their QUALITY RECEIVING SETS, are equipping all their sets with Thordarson super-transformers.



BE CONVINCED

ZENITH
TRADE MARK

The Zenith Radio Corporation, manufacturers of LONG DISTANCE RADIO RECEIVERS, famous for the Berengaria record and their accomplishments on the S. S. Bowdoin at the North Pole, also have adopted Thordarson super-transformers as standard equipment.

SUPER TRANSFORMER

THORDARSON

ELECTRIC MFG. CO.

TRANSFORMERS FOR EVERY PURPOSE

500 W. HURON ST., COR. KINGSBURY
CHICAGO

upon hearing some uncommon sound coming from the interior of the very complicated mechanism which he controls is immediately able to judge as to the seat of the trouble and remedy it before disaster results? Experience, is the answer. Therefore if your receiver does not operate satisfactorily the first time you work it bear in mind that it is probably owing to some fault of your own, and that there is nothing wrong with the receiver for it was designed by a man who knew his business and that in addition it was not the first receiver which that particular company constructed. Therefore if trouble is experienced have a little patience and remember, "It is a poor workman who blames his tools," as an old and very true saying has it.

In the final series of tests a regenerative receiver was used using the so-called Reinartz adaptation which had been constructed by two students at the Radio Institute of America. The set-up for this test is shown in figure 9. Figure 10 gives the diagram of connections of this set which was included because it has been stated so many times and in so many places that it was impossible to use this circuit with radio frequency amplification. It was considerably worth while to explode that bubble once for all by giving the circuit and photographs of the set-up as actually used. In this circuit as well as with all of the other circuits which were made use of in these tests it was found possible to have excellent control of the regeneration by the operation of the usual regenerative controls of the receivers and that the various tuning elements functioned as well when used with the radio frequency units as without it.

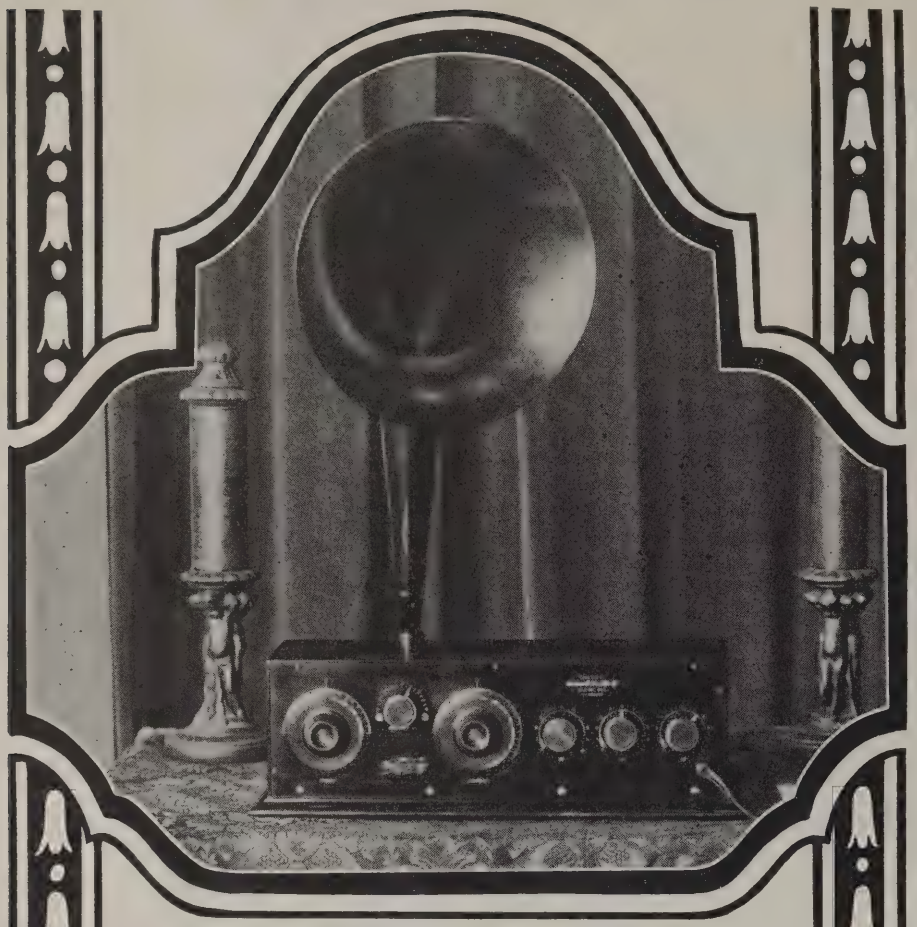
Speech Amplifier

(*Continued from page* 64)

the distance between the grid and the plate end and when the set is in operation the exact point for this ground tap can be found by adjusting it to give minimum plate current with maximum oscillatory current. This circuit is coupled, very loosely, from the high potential side to the high side of the UL-1008, .06 mh. antenna coil. The capacity of this coupling condenser should be approximately .00002 mfd. and can be made of two copper discs about 12 inches in diameter supported on adjustable insulated stands so that they can be moved closer together or farther apart to increase or decrease the capacity to get the proper amount of coupling.

ANTENNA CIRCUIT

The antenna is connected to the antenna coil through a UC-1015, .0005



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NO LOOPS NO ANTENNA

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Stations within a radius of 2000 miles can be picked up on the loud speaker; any wavelength from 200 to 700 meters.

Price $150.00

Write for illustrated folder which describes the RADIODYNE in detail.

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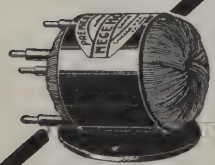

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Mounts anywhere—save space in assembly. We guarantee it unconditionally. Try them in your next "hook up." Ratio 1 to 3, 1 to 4, 1 to 5, $3.50; 1 to 10, $4.50. Ask your dealer. Write for bulletin No. 92.

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By W. J. Merritt Garvey, of New York World's Radio Section, Handbook of Helpful Hints for Radio Set Builders, includes tables, charts, legends, statistics and carefully selected hook-ups with diagrams and full descriptions. Reading this interesting book we discovered Mr. Garvey recommended the FIL-KO-STAT. We bought an edition of the books and will gladly send a copy anywhere at handling cost 10c. postpaid.

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Dept. WA 12-218 West 34th St. New York.

mfd. condenser and the ground is connected to the other end of the coil through a 0-10-ampere radio frequency ammeter.

Now the circuit is complete, and with the oscillatory adjusted to give maximum radiation and highest efficiency we can apply the speech amplifier and note how it functions.

Functioning of the Circuit for Phone Work

Now we come to the question of the switches A, B, C, D and E. For phone work we have the following conditions as shown by the chart in figure 1: A closed; B open; C closed; D open; E closed.

This also seems to be the proper time to explain how the bias on the UV-203 modulator tube is adjusted by means of the 5000-ohm potentiometer. We already have good quality speech coming from the output of the speech amplifier and in order to put this good quality on the air it is necessary to have the modulator grid biased by the proper amount. If there is a D.C. potential of 300 volts on the plate of the speech amplifier then, since the potentiometer is directly across the D.C. supply, point x is negative and point y is at plus 300 volts. Now, since E is closed to ground as well as the filament of the modulator, these two points being at the same potential, electrically they are the same, so we will consider point E the modulator filament. Also, since point x is connected to the modulator grid we can call it the grip point. Therefore, if we had the pointer of the potentiometer E at point x, E and x would be at the same potential, thus, the filament and the grid of the modulator would be at the same potential. Now if we moved the pointer E toward y to a point at plus 10 volts, for instance, we would have the ground or filament at a point 10 volts higher than the grid; or saying the same thing in other words, we would have brought the grid to 10 volts negative with respect to the filament. We have biased the grid 10 volts and we could continue to still further bias the grid until we got it at a point 300 volts below the filament, but this would be unnecesary because the tube would have blocked with a negative bias far less than this. The beauty of this circuit is that we can adjust the negative bias of the modulator while the circuit is in operation and can consequently get the quality down to the finest point possible. It would be simply necessary to connect a pair of telephone receivers to a wavemeter or receiving set with the antenna disconnected—using the primary coil for a pick-up—and after tuning in the speech we could adjust

"It's real fun to tune-in now— since Jim equipped our set with

ACCURATUNE

MICROMETER CONTROLS

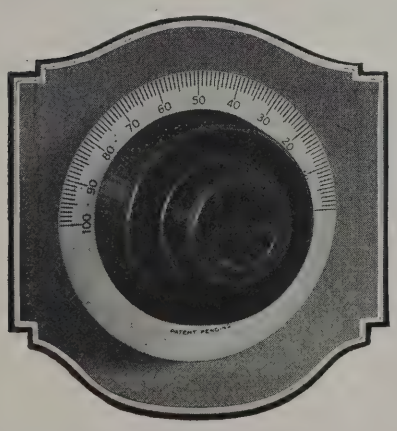
"THERE are no more of those exasperating 'hide-and-seek,' preliminaries that used to try my patience so, especially with the new wave lengths. Instead of waiting till Jim comes home to fuss and fumble with the old vernier things, which I never could master, I can do all the tuning, now, myself.

"You must not confuse the Accuratune with any of those so-called vernier attachments or 'mere dials.' It's a real control ten times as accurate as any vernier and far more simple to operate. Just by the slightest turn of the micrometer knob I can easily get station after station, clear and distinct, in half the time Jim formerly took.

"As for the cost, Jim agrees we got $3.50 worth of pleasure and satisfaction from the Accuratune the first week we used it. In fact, he was so delighted with it he immediately bought a Fixt-Post Switch and a set of Rheostat Dials made by the Accuratune people, and which match the Micrometer Controls to a 'T'. The appearance of our set has been increased 100% and you can do the same with yours, too."

Universal micrometer action and easily fingered knobs are the outstanding features of the Accuratune Control. The larger knob is used for coarse adjustments, the smaller knob operates the micrometer mechanism. Either action will swing the dial through the full 360 degrees. Your dealer will supply you with Micrometer Controls for your present set, or if you are buying a new set, choose one equipped with Accuratunes.

Manufacturers of popular sets: Equip your apparatus with Accuratune products. Increased efficiency and beauty will advance your sales.



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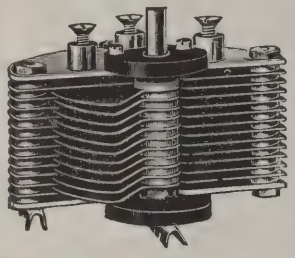

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23 Plate... 2.00
43 Plate... 3.00
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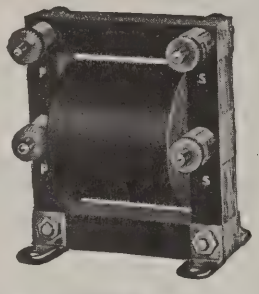

Amplifying distortionless Transformers, correct for any tubes.

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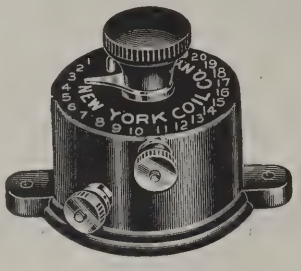

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Of tested and permanent capacity, ranging from .0001 to .0006, 35c to 75c, of superior quality.

.00025 with Leak Mounting, 45c

Our Variometers and Couplers are large, full size instruments—correct for complete broadcast range.

VARIOMETERS $3.50 **180° COUPLER $4.00**

90° COUPLER $3.50

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Radio Companies frequently find it necessary to scour the country for licensed operators. In a number of cases ships have been held up and in a few instances vessels have had to clear port without operators.
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Study Radio in a recognized school. Write to-day for illustrated booklet.

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149 East 86th Street **New York**

the modulator bias until the quality of the speech was best.

I.C.W. Operation

For I.C.W. we have A open, which cuts out our smoothing condensers; B closed, which short circuits our 1000-cycle trap; C open, which cuts out one kenotron and thus gives half-wave rectification or a 500-cycle ripple; D open and E closed which gives us our proper modulator bias for good modulation. Now, with our filter condensers and our trap circuit cut out and one kenotron out of the circuit, the 500-cycle ripple goes through to the grid of the modulator and the high frequency current being radiated is modulated by this 500-cycle note, which is a very pretty note.

C.W. Operation

For C.W. transmission all the switches are back to the position they had in phone transmission except D and E. D is closed and E is open, which throws the grid of the modulator 300 volts negative, so far negative in fact that it blocks and refuses to function, the result being that a pure unmodulated C.W. note is radiated.

All of this switching in the speech amplifier circuit can be taken care of by means of a single gang switch with five elements. An element for each one of the switches, there being three positions of this gang switch, namely, phone, C.W. and I.C.W. The use of the gang switch for the speech amplifier unit was the method employed by the writer.

DX Reception in the Grand Canyon

(*Continued from page* 18)

Little Colorado, and 225 miles below the starting point of the expedition, at Lees Ferry. Here they were met with supplies and mail and with newspapers containing wild accounts of possible disaster to the party in the big flood. One of the accounts stated that an overturned boat marked "U. S. G. S." had been seen below Boulder Canyon, and it is true that one of the Survey's boats at Bright Angel, used in hydrographic work, broke loose and was carried away, but the description of the boat seen does not tally with this boat, so perhaps the boat seen was one of those of the U. S. Reclamation Service, marked "U. S. R. S." Here the boats were overhauled, reports were prepared, the equipment was examined, and the radio outfit repaired and set up, where it received messages from Los Angeles and elsewhere, among them the broadcast telegrams announcing the safety of the party.

The voyage was resumed October 7, when the boats plunged into Diamond Creek Rapids. A couple of the boats

Why do you do it?

O' HELLO LIL. SAY, THE SMITHS ARE COMIN' OVER T'NIGHT
AN' A GOOD PROGRAM ON TOO O BOY!!
-R-I-N-G-
GOSH— NO SOUND—NO JUICE— AND HERE THEY COME!*@*!!
HELLO, JOE, WHAT'S UP- Y'LOOK BLUE
AW-W-HULLO
JUST T'NIGHT MY BATT'RY GOES SOUR, AN' NOW I'LL HAVE T'LUG IT OUT TO GET IT RECHARGED!
BUT LISSEN JOE
WHY DO YOU DO IT?—USE YOUR ELECTRICITY AND CHARGE IT YOURSELF—HOME—WITH A TUNGAR
TUNGAR CHARGES OVER NIGHT

Is your battery always fully charged and fit?

Is it always toned up for best results whenever friends happen in—throughout every concert?

Keep it at full strength the simple, easy, inexpensive Tungar way.

Tungar—the go-between from house lighting circuit to battery—attaches wherever there is a lamp or a convenience outlet.

You don't have to move the battery. Just connect Tungar, turn on the current and leave it, any time day or night.

Tungar is *certain, clean, quiet.* There are no moving parts to get out of order or make noise. Its cost of operation is low.

Regular charging with Tungar keeps the battery in the pink of condition for every concert and prolongs its life.

Good for the auto battery too—the *same* Tungar.

See one at any good electrical shop, or write for literature. Address Section **WA-1.**

Merchandise Department
General Electric Company
Bridgeport, Connecticut.

Tungar Battery Charger
Operates on Alternating Current
2 Ampere Outfits complete, $18.00
5 Ampere Outfits complete, $28.00
(Prices east of the Rockies)
Special attachment for charging 12 or 24 cell "B" Storage Battery—$3.00 —fits either size Tungar.

Charge 'em at Home, with

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BATTERY CHARGER

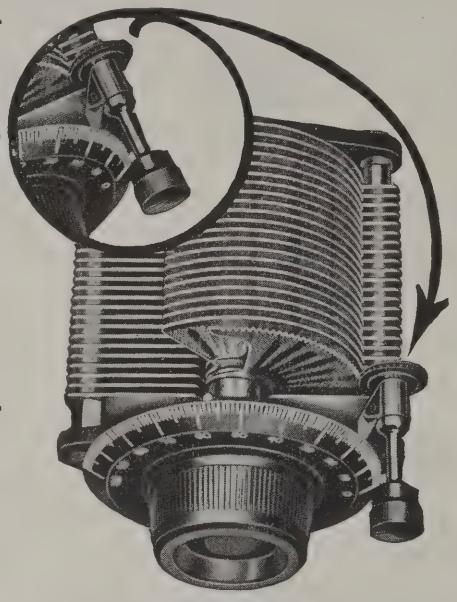
A GENERAL ELECTRIC PRODUCT

Impartial Experts Testify!

For a long time, set builders have wanted some definite, authoritative guide to condenser quality. Complying with this demand, HEATH RADIANT CONDENSERS were submitted to two of the greatest radio testing laboratories. Below are salient phrases from their reports. Copies of the complete reports free to anyone interested.

Electrical Testing Laboratories of New York Say—

". . . the equivalent series resistance of each of the condensers is very small. That is, it is *so small* that it may be considered as *negligible*."



Radio News Laboratories Says—

". . . considered one of the best condensers we have tested. A dielectric loss resistance of 46 ohms at 1000 cycles . . ."

HEATH RADIANT CONDENSERS

Permanently Flat Plates

Precise, when you examine it at the store and, still more important, p-r-e-c-i-s-e *always,* for years—the most durable, continuously efficient part of your set. Warping plates made *impossible* by the *Heath* process of stamping and hardening which makes each one permanently FLAT.

Micrometer - Adjusting Geared Vernier

Reducing gear, engaging with teeth cut into the outer rim of the vernier plate, affords infinitely delicate adjustment. An added feature of satisfaction that makes it well worth your while insisting upon *Heath Radiant Condensers.*

Write for Booklet

List Prices—Vernier Type—(With 2 7/8" dial and knob)
13 Plate $5.00 25 Plate $5.50 45 Plate $6.50

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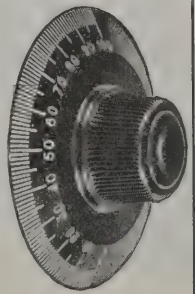
When phonographs were first made they were square boxes without ornamentation. Likewise the first dials,—turned out in a laboratory,—had hard straight lines for shape. Beauty is a later development. Na-ald dials have soft, graceful lines which make them very pleasing to the eye. They lead in both beauty and quality. They have the right grip for delicate, exact tuning.

Alden Manufacturing Company Largest makers of Radio sockets and dials in the world. Springfield, Mass. Dept. A 52 Willow Street.



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OILED TUBING

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were upturned, but without serious accident to the party or to the apparatus, although many loose articles such as glasses, pipes, etc., were lost.

The accident afforded a good test of the serviceability of the water-tight boxes, one of which, containing cameras, was strapped in the open cockpit of the overturned boat. After a half-hour's submersion the cameras and films were found to be bone-dry. In camp that night the repaired radio set gave the party messages from Los Angeles and Salt Lake City, and, for the first time, from Colorado Springs. The most interesting items of news were accounts of the results of the first two baseball games in the world's series.

October 19 the party reached Needles, 450 miles from Lees Ferry, bringing to an end one of the most remarkable surveying expeditions of all time.

The ease with which the party picked up broadcasting from distant points is all the more remarkable, not only because of the great depths of the canyon, but also on account of frequent "dry" thunderstorms in August and September.

Colonel Birdseye stated that although Los Angeles and San Francisco were never less than 400 or more miles away, it was seldom necessary to use the second stage of amplification to hear stations in those cities plainly. Yet, all this broadcasting was heard when the receiving set was from a thousand to five thousand feet below the rim of the canyon.

The party, which was selected with especial care, consisted of well-seasoned, experienced men, comprising, besides Colonel Birdseye, E. C. LaRue, hydraulic engineer, who for several years has been studying the problem of utilizing the waters of the Colorado River; R. C. Moore, State Geologist of Kansas, who for two years has been making geological investigations in Utah and Arizona; R. W. Burchard, topographic engineer; Emery C. Kolb of Grand Canyon, who in 1911, with his brother, made a boat trip from Green River, Wyo., through the Grand Canyon to the Gulf of California; L. R. Freeman of Pasadena, Calif., a well-known explorer, writer and boatman; Leigh Lint of Weiser, Idaho, and H. E. Blake, Jr. of Monticello, Utah, two husky youngsters with two years' experience in boating the rapids of the Colorado; Frank B. Dodge of Honolulu, a skillful boatman, expert swimmer and general utility man, capable of filling any position from instrument man to cook, and a cook.

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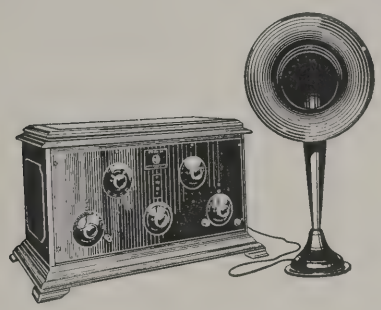
"New York's Leading Radio House"

THE SYMBOL OF SERVICE

Radiola VII

Distributors for the Radio Corporation of America



"The Radiola Pathfinder"

The Radiola VII is made up of two stages of transformer-coupled Radio frequency amplification, detector, and two stages of audio frequency amplification.

It is a two circuit Tuner designed for use with Radiotron UV-199 dry cell tubes, entirely self contained in a mahogany box with piano-hinged lid.

It is simple to operate yet very selective in tuning. Economy and efficiency are only two of the many advantages which the Radiola VII has over other sets of today.

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The unexcelled performance of Federal Standard Radio Products

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Federal Head Sets are one of the more than 130 radio products which Federal manufactures and guarantees. Your receiving set is no better than its weakest part. Insist on Federal.

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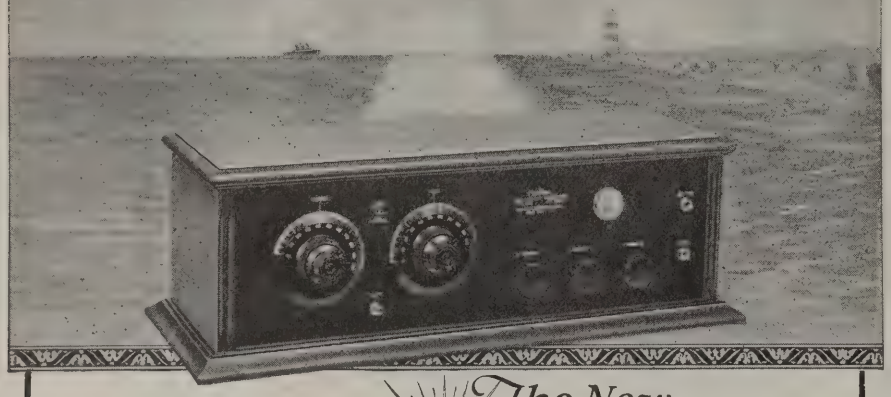

The New

MU-RAD RECEIVER

MA-15

THE HORIZON of the radio art extended and broadened by this new perfection of radio reception—the more versatile, more simply operated receiver, *Mu-Rad MA-15*. Many important refinements—plug-in type radio frequency transformers, so that the MA-15 can be accommodated to any future changes of wave lengths or tubes, volt-meter for instantaneous readings of "A" or "B" batteries, new type vernier dials, operated by cams to eliminate back-lash, no other aerial than a 2-foot loop needed, and a wave length switch for bringing in short wave stations. Solid mahogany cabinet, with an engraved Formica panel. The MA-15 anticipates every possible use and requirement. *Guaranteed range, 1,000 miles using 2-foot loop.*

Another New MU-RAD Receiver MA-17

Three stages of radio and two of audio frequency amplification and detector. *One* tuning dial and two selecting dials, each independent of the other. Plug-in type r. f. transformers to care for changes of tube type or wave lengths. Panel-mounted volt-meter for quick reading of A and B batteries. Solid mahogany, Adam Brown hand-rubbed finish cabinet with loop fitted into top and compartment in base for "B" batteries. Guaranteed for 1000 miles reception using only a 2-foot loop.

WRITE FOR BOOKLET AND NAME OF NEAREST DEALER

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RADIO FANS

Tune in on station
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Write for Free Copy of the Latest Radio Reprint D. It contains a complete story from Hearst's International Magazine. Address Radio Editor, Hearst's International Magazine, 119 West 40th Street, New York City.

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to the first 1,000 fans who send in a 2c. stamp and the names and addresses of five friends who are interested in Radio.

ESSEX MFG. CO., 119 Mulberry St. Newark, N. J.

Wild Rodeo Warriors at WJZ

(*Continued from page 27*)

it. Arms brandishing, bodies twisting and swaying, tom-tom beating a dull ferocious rhythm of concentrated passion, the three howled and wailed and howled again, until even the blase switchboard operator outside left her post to see what murder was under way.

The whole aspect of the affair was changed—no longer was the chief concern of Scott the enticing of the braves to the microphone; it was the much graver one of keeping them away from it, of removing them ere physical mutilation was performed upon the defenseless instrument.

"How — hy — a — roo. C'mon!" shouted the guide, swinging an imperial arm toward the door leading from the studio.

"Hy-e-e-e-e- How-o-o-o-o- Hy-a-a-a-a-a-a-a-" shrieked the frenzied braves unheedingly, threatening the "box-on-the-stick" with dire death.

"Hy! C'mon! APPLE-PIE!" yelled Scott.

Silence rent the howl-filled air. Three braves formed the battleground for a bitter struggle between pie-loving stomachs and vengeance-thirsty souls. The stomachs won. Eager anticipation upon their bronzed faces, childish delight sweeping aside all passion, they padded docilely across the studio to the door and their paternal guardian Scott.

And the wild and woolly West left a somewhat quavery-minded East to heave huge sighs of relief and resume its civilized methods undisturbed by aborigine attacks.

The Chicago Radio Show

(*Continued from page 26*)

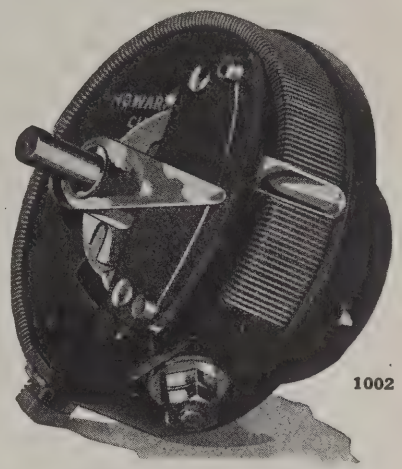
The four center booths were occupied by Kennedy, Grebe, Crosley and Zenith. In the Kennedy booth were found the handsome new Kennedy furniture models which show so well the present day trend of radio development. All these sets of course were of the regenerative type. In the Grebe booth were found all the latest regenerative sets brought out by this well known old-timer.

Crosley had on exhibition the complete Crosley and Precision regenerative lines, together with a monster receiving set which required a truck for conveyance drawn by an elephant. This set had concealed within it a standard Crosley receiver with power amplifier and loud speaker, and when drawn through the streets of Chicago by the elephant attracted as much attention as the average circus parade.

Howard Radio Co. Inc. BLUE SEAL GUARANTEED PRODUCTS Chicago, U.S.A.

—on Radio Parts means Quality and Perfection

Here's the HOWARD Master RHEOSTAT



1002

This well-known HOWARD Micrometer, with instantaneous, SINGLE-KNOB CONTROL, is the smoothest running, the simplest and most easily adjustable rheostat made.

The **single** knob gives coarse or fine adjustment—instantly, accurately and easily. The micrometer sector is carried along with the main control and can be brought into use at whatever point desired.

Absolutely guaranteed. Highest grade materials used. Careful inspection and testing before shipment. Wire has practically a zero co-efficient, insuring perfect stability in operation. Carrying capacity 1½ amps.

6¾-ohm Micrometer Rheostat, $1.50—with dial, $1.75; 25 and 40-ohm Micrometer Rheostat, $1.50.

Ask your dealer to show samples of our product. Jobbers write for discounts direct.

HOWARD RADIO CO., Inc.
4248 No. Western Ave., Chicago, Ill.

1001—The standardized Rheostat, furnished in three resistances, to fit all tubes.

6½	Ohm Rheostat.....Price	$1.10
25	Ohm Rheostat.....Price	1.10
40	Ohm Rheostat.....Price	1.10
60	Ohm Rheostat.....Price	1.10

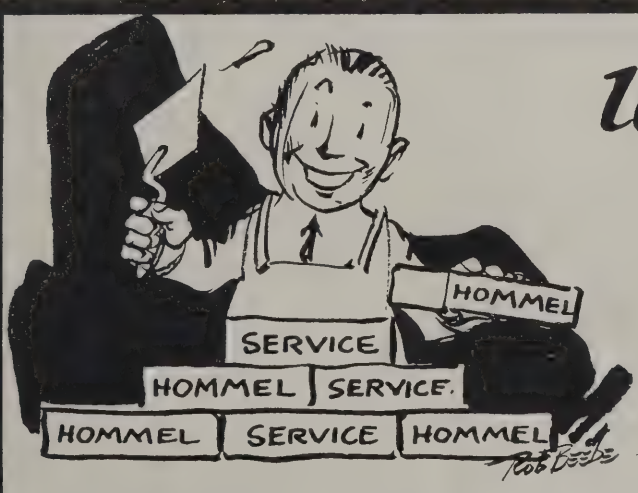
1003—The Howard Potentiometer, with its fine turns of constant-resistance wire, spaced to hair-breadth accuracy, is contributing an important share to the splendid results now being obtained with radio-frequency sets:

200	Ohm Potentiometer.....Price	$1.50
400	Ohm Potentiometer.....Price	2.00

1004—Accommodates up to six pairs of phones, and gives instantly any desired series or parallel connections:
Multi Terminal Receiver Plug....Price $2.00

1005—The Inductance Switches have the same handy knob as the famous Rheostat. The switch blade is of finest phosphor bronze, keyed to the knob, and when adjusted to the desired pressure on the points it will not vary or come loose:

Large Knob Inductance Switch....Price 50c
Small Knob Inductance Switch....Price 50c
(1" Radius)



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Dr. Wm.D. Reynolds,
Denver, Colo.

Hyattville, Wyo.
May 30. 23.

Dear Dr:

As to results obtained with the little Electric Specialty Dynamotor, I am pleased to say I have been getting wonderful results with it, but instead of running off 6 volt battery, have been using an 8 Volt, which gives me a high voltage of 600 Volts and, what everybody says, a Beautiful Tone, every card I get mentions that a fine note I have; I have talked Fone (using loop modulation) with 5SK at Fort Worth Texas, after daylight in the morning, Falconi at 5ZA Roswell New Mex. says my fone so QSA he can hear it 10 feet from Fones, and work him with CW way after sun rise, which is going some; I work most all the Boys in Denver and they're all crazy about my tone. I am more than pleased with the Dynamotor, and any time I can be of service to you regarding its action just let me know.

Yours truly,

L.G. Van Slyke

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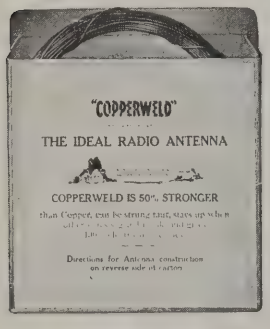

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Strongest—Most Efficient—Best

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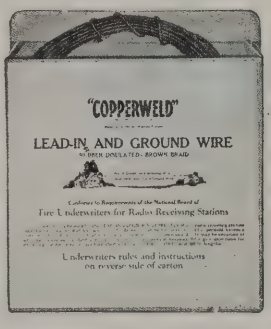
Strong—Efficient—Durable—Inconspicuous
Has the Underwriters' OK



100, 150 & 200 ft. per carton

25, 50 & 100 ft. per carton

The construction directions and Underwriters' regulations on the carton answer all questions

SAVE TIME — BUY IT IN CARTONS

"COPPERWELD"

MADE EXCLUSIVELY BY THE COPPER CLAD STEEL COMPANY

New York, N. Y.	Rankin, Pa. (Pgh. Sub.)	Chicago, Illinois	San Francisco, Calif.
30 Church Street	Braddock Post Office	129 S. Jefferson Street	403 Rialto Building

Zenith displayed a new line of regenerative receivers with the new three-stage amplifier in various cabinet designs, the most outstanding feature being the combination of the Zenith receiver with the Brunswick phonograph. In the center of the booth under a spotlight was displayed a 300-pound cake of ice having frozen within it a copy of the last message received from the MacMillan North Pole Expedition, several days before the show, telling how glad MacMillan was to have Zenith radio with him which was giving him entertainment, news and messages from home. The ice surrounding this message attracted much comment, and certainly created a cooler atmosphere.

The United Manufacturing & Distributing Company nearly broke up the show on one particular evening by shooting out from the balcony 10,000 small toy aeroplanes. The crowd went wild in their efforts to obtain these toys and the disturbance became so great that the show management finally had to put a stop to it.

In the Fansteel booth was found the new Balkite Rectifier for battery charging. This new development attracted much interest.

H. H. Frost of Chicago, in addition to displaying the largest pair of headphones ever built, had among the personnel in his booth a highly decorated individual carrying a sign, "The Man Who Never Smiles—Make Me Smile and Get a Pair of Frost-Fones Free." From all reports the correct way to make the gentleman smile was to wiggle your ears.

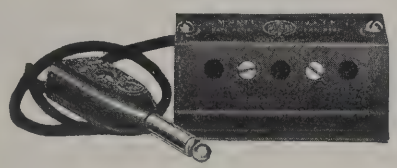
In the booth of the Electrical Research Laboratory, making the well known Erla reflex apparatus, was found a highly educational and an extremely attractive exhibit showing the action of the Erla reflex circuit. The tubes, coils, condensers, etc., were illustrated in electrically lighted glass form; the wires connecting them being Giessler tubes of special construction. By an automatic switching arrangement the current was thrown off and on these various circuits so that the onlookers could follow the course of a signal through the circuit out to the loud speaker.

The National Carbon Company displayed a giant panel with meters that could be seen 100 feet away. This display showed the operation of various types of tubes with various values of grid and plate batteries. The operator of the apparatus talked through a Western Electric announcing system with a horn which was suspended above and directed immediately on the crowd in front of the booth, making this an extremely successful and educational exhibit.

The French Battery and Carbon

PACENT PLUG and JACK DEVICES

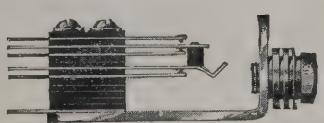
For Every Radio Requirement



Pacent Jackset—A de luxe accessory for making multiple connections. Cat. No. 5240. **Price, $1.75.**

Pacent Multi-adapter—Provides one to five plug connections. Cat. No. 54. **Price, $1.50.**

Pacent Duoplug—A quality plug for most particular radio users. Accommodates two pairs of phones. Special toggle feature insures positive contact. All types terminals. No tools required. Cat. No. 100. **Price, $1.00.**



PACENT JACKS

There is a Pacent quality jack for every circuit. Ten styles. Nos. 61-70. **Prices 60c. to $1.00.**

The New Catalog

Additional Pacent plug and jack devices and other radio essentials are described in the new Pacent Catalog No. W-12, sent free on request.

Pacent Electric Co., Inc.
22 Park Place New York

Sales Offices: Chicago, Philadelphia, St. Louis, San Francisco, Minneapolis, Washington, Jacksonville.

Pacent
RADIO ESSENTIALS

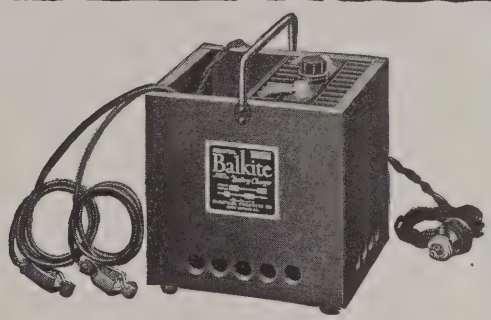
PREPARED RADIO MEASUREMENTS
with
SELF COMPUTING CHARTS
By Ralph R. Batcher

A book that is devoted entirely to simplifying the methods of determing electrical and geometrical constants for radio instruments and appliances.

The accuracy of these charts is above the accuracy with which the various factors that enter in the formulas can be measured with ordinary means.

Price $2.00

WIRELESS PRESS, INC. 326 Broadway, New York



The FANSTEEL

Balkite battery charger

PATENTS APPLIED FOR

has no vibrators, bulbs or moving parts and is entirely noiseless

FANSTEEL BALKITE

is a new metal developed for this charger. It acts as a valve, allowing current to flow into the battery but not out of it. It is the most efficient charger valve made, is practically indestructible, and does away with noisy, delicate vibrators and fragile bulbs.

The Gould Storage Battery Company is also marketing, under the Fansteel Balkite Patents, a complete battery and recharging unit known as the Gould Unipower, into which this charger, under the name, "The Fansteel Balkite Rectifier," has been incorporated.

The Fansteel Balkite Battery Charger for Radio "A" Batteries [6 volt] is an entirely new type of rectifier, based on the use of Fansteel Balkite, a new and rare metal developed for this purpose. It is entirely noiseless. It cannot deteriorate through use or disuse. It has nothing to replace, adjust, or get out of order. It cannot discharge or short circuit the battery, and requires no attention other than an occasional filling with distilled water. It will not overcharge, and cannot fail to operate when connected to the battery and line current. It is unaffected by temperature or fluctuations in line current. It is simple, efficient, and indestructible except through abuse.

The Fansteel Balkite Battery Charger will charge the ordinary 6 volt radio "A" or automobile storage battery at 3 amperes, from 110-120 AC, 60 cycle current. It comes complete and ready for use. Get it from your dealer, or use the coupon below.

Price, $18

($18.50 West of the Rockies)

FANSTEEL PRODUCTS CO., Inc.
Dept. 7-B North Chicago, Illinois

Dealers and Jobbers: The Fansteel Balkite Battery Charger does away with complaints and replacement troubles. Write for literature and discounts.

Dept. 7-B

FANSTEEL PRODUCTS CO., Inc., No. Chicago, Ill.

Enclosed please find $18. ($18.50 west of the Rockies.) Send me the Fansteel Balkite Battery Charger for Radio 6 volt "A" Batteries. If I am not entirely satisfied I will return it and you will refund my money.

Name .....

Street .....

City ..... State .....

ELECTRAD PRODUCTS

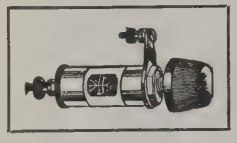
The NEW DIODE

Discard crystals! Use the Electrad Diode in all circuits. Overcomes former difficulties with reflex work. Gives greater volume, greater selectivity and steadies the circuit. Eliminates tedious adjustments for change of wave lengths. A perfect detector tube. Real results. Absolutely guaranteed.

$2

Socket 50c

RADIO'S GREATEST INVENTION



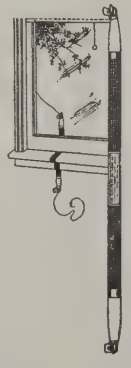
The NEW VARIOHM

Double your receiving distance. Give the precision value of grid leak resistance your detector tube requires. Variohm does the work of a thousand ordinary grid leaks. Resistance variations secured are infinitely close and gradual, not by steps and jumps. Range ¼ to 10 megohms. Increases volume. Eliminates circuit noises. Enables you to get distant stations clear and distinct. Absolutely guaranteed.

75¢

The LEAD-IN

Fits right under closed window. Can be bent into any shape to fit ledges. Covered with fire-proof insulating material which prevents grounding of circuits on wet window sills. Takes the place of ungainly porcelain tubes and holes in the window sash. Always presents a neat appearance. Fitted with Fahnestock clips.



40¢

All products at your dealer's, otherwise send purchase price and you will be supplied postpaid.

Write for FREE Cockaday-Diode Reflex Circuit.

ELECTRAD, Inc.

428-D BROADWAY

NEW YORK

The Supreme Insulation

RADION Panels

are easiest to drill, saw, or engrave with simple tools at home

18 Stock Sizes Radion Panels

Mahoganite and Black

6 x 10½	6 x 14	6 x 21
7 x 9	7 x 10	7 x 12
7 x 14	7 x 18	7 x 21
7 x 24	7 x 26	7 x 48
9 x 14	10 x 12	12 x 14
12 x 21	14 x 18	20 x 24

Look for this stamp on every genuine RADION Panel. Beware of substitutes and imitations.

American Hard Rubber Co.

11 Mercer Street **New York**

Company showed the fans, through a graphic push button board the "cents per hour" battery cost of the various types of tubes.

Several neutrodynes were shown, including the Fada and the Garod. The Western Coil and Electric Company exhibited their new Radiodyne set.

The desire of the radio fan for real information in all phases of radio was strikingly shown by the way they flocked to the booth of the various publishers. Needless to say THE WIRELESS AGE got its share of the subscriptions returned at the show.

It is of course impossible to give all the exhibitors the praise that is due them, and all that can be done in writing up a show of this kind is to cover the high lights which stand out from the kaleidoscope of impressions.

It was a great show, and there is no question but that every exhibitor was well repaid for his expenditures both of money and of time. If progress along the lines of radio show attendance is as great next year as it has been during the past year, it will be impossible to find a hall big enough to hold the next Chicago Radio Show.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. Lists will be published in issue immediately following receipt of list. Spark and C. W. stations should be arranged in separate groups.

2CTN—J. M. Cummings, Richmond Hill, N. Y.

4sb, 4ku, 4eb, 4db, 4yi, 4mb, 4na, 4qf, 5vv, 5ahh, 5aiu, 5amh, 5abt, 5gm, 5kg, 5gj, 5agd, 5be, 5lr, 5tj, 5kw, 5in, 6bqe, 6ka, 6bbc, 6pl, 6cgp, 6cfz, 6awt, 7zu, 7abb, 7ln, 9apf, 9ahz, 9blg, 9bfi, 9dhg, 9ekf, 9cjc, 9dsw, 9bqy, 9avg, 9ceh, 9dmj, 9bwv, 9cga, 9ck, 9dgw, 9ctr, 9ddp, 9dkx, 9dpc, 9eht, 9dej, 9cgy, 9ccs, 9eky, 9cog, 9com, 9bik, 9bis, 9aal.

6BSR—WM. KRAUSE, Los Angeles, Cal.

Can. 3bp, 4ft, 4cs, Can. 5cn, 5zav, 5avo, 5de, 5adb, 5ah, 5go, 5lr, 5sn, 5in, 5nn, 5ph, 5lr, 5la, 5dv, 5adb, 5fa, 5gn, 5ana, 5akn, 5yn, 5nn, 5me, 5gj, 5gn, 5in, 7ks, 7aiy, 7ed, 7zo, 7iw, 7asn, 7oe, 7lw, 7qw, 7ya, 7zz, 7wm. 7aci, 7dc, 7io, 7ae, 7nt, 7aci, 7zz, 7lw, 7js, 7xt, 7ahi, 7to, 8aah, 8bfm, 8bda, 9bez, 9apf, 9mk, 9pw, 9dqu, 9bji, 9ajg, 9dkb, 9bun, 9cfy, 9os, 9bsp, 9dew, 9eky, 9bly, 9cte, 9cvc, 9dzy, 9bzi, 9ctg, 9aon, 9bal, 9aps, 9aou, 9apa, 9zt, 9zav.

9ZT—D. C. WALLACE, Minneapolis, Minn. Heard during November. All districts worked.

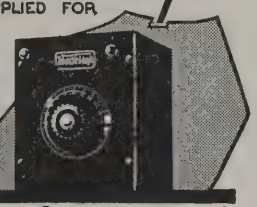
(1er), (1hx), 1ll, 1sn, 1xm, 1vv, (1yb), 1yd, 1yk, 1ada, 1aja, 1aqi, 1bcg, 1bgk, 1boq, (1ckp), (1cmp), 1crw, 1csu, (1xaq), 2ah, 2bx, (2gk), 2ig, 2kf, 2ku, 2pa, (2rb), 2rk, 2sh, 2ts, 2wb, (2xq), 2afp, 2agb, 2ana, 2awh, 2bkq, 2bmr, 2brh, 2brb, 2brc, (2bte), 2bxp, 2bxw, 2cfb, 2cjr, 2cka, (2cqz), 2csl, (2cxd), (2cxf), (2xaq), 3ab, 3bw, 3hg, 3hs, 3jj, 3me,

FERBEND

TRADE MARK

Wave Trap

PATENT APPLIED FOR



The Original Wave Filter

Stops Interference!

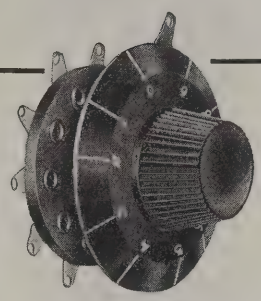
Eliminates interfering stations.
Improves the selectivity of the set.
Eliminates local broadcasting.
Selects between conflicting stations.
Simplifies tuning.
Often increases signal strength.
Reduces howling and squealing.

The WAVE TRAP is mounted on a Formica panel in a beautiful mahogany finished cabinet 6x5x6, and is a high grade instrument throughout enhancing the appearance of the most expensive sets.

8.50 CHARGES PREPAID

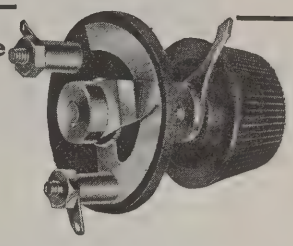
Ferbend Electric Co.
18 E. SOUTH WATER ST.
CHICAGO

WALNART TWINS



Variable Grid Resistance
$1.00

Inductance Switch
$1.25



To get distance you must have positive contacts. The average arrangement of switch points is not satisfactory. Walnart inductance switch gives positive contacts—insuring better reception.

Different tubes require different grid resistance—Walnart Variable grid resistance varying from minimum to maximum of six Megohms clears up signals and adds to the efficiency of the set.

The instruments are made of highest quality material; base is genuine Condensite-Celoron made under Bakelite patents.

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A REAL OPPORTUNITY as SALES ENGINEER

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Qualifications:

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Preferably Member A. R. R. L.

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—for—

Colorado, New Mexico, Idaho, Montana, Wyoming, Western Kansas and Utah

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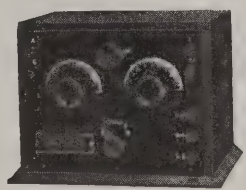
The Rocky Mountain Radio Corporation
1512-1516 Broadway, Denver, Colo.

WOC-TRESCO

Licensed Under Armstrong U. S. Patent No. 1,113,149



A long distance 1,000 mile 600 meter range regenerative tuner for $10.00—add parcel post on 6 lbs. New circuit, startling results. Cheaper than crystal set. Uses any aerial. Amplifiers to match set for your loud speakers. Circulars free — full instructions.

TRESCO Davenport, Iowa

COLD WINTER NIGHTS

Won't find you on the roof fixing the aerial—removing snow and sleet, exposing yourself to sickness, if you use

ANTENELLA

(No aerial or antenna needed.)

A light socket plug that eliminates all outside wiring, lightning arresters and other inconveniences. Merely plug Antenella in any light socket and you can enjoy the best in radio in any room in the house.

Now Only $1.25

At your dealers—otherwise send purchase price and you will be supplied postpaid.

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Radio Condenser Products
106 Seventh Ave., New York

Sterling

RADIO EQUIPMENT

for the fan who cares

If you are always on the alert for improvements—if you are striving to make your radio set as "human" as possible—if you want to feel confident of getting the station you want—

then the Sterling Radio Family should be introduced to the rest of your equipment.

Sterling Radio Equipment will not interest you if you want *cheap* parts. But if you want to add refinement to your set that otherwise would not be possible, start to use Sterling parts now.

For charging your battery The New Improved Sterling Rectifier, $16.00. Add $1.00 *West of Rockies.*

For testing radio A & B batteries, Sterling Pocket Meters, $1.00 *to* $4.00

For fine regulation of current, Sterling Rheostats, 75c *to* $1.00

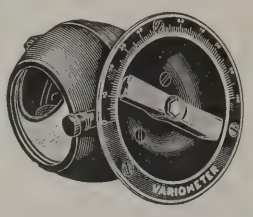
For better amplification, Sterling Audio and Radio Amplifying Transformers, $4.00

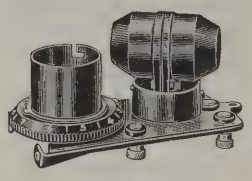
For variocoupler connections and panel appearance Sterling 12 *point Rotary Switch,* $1.50

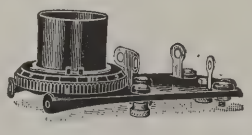
For protecting your instruments, Sterling Filament Meters, $4.00 *and* $5.00

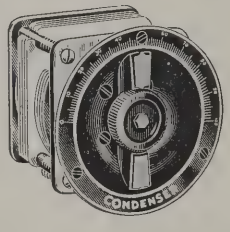
For charging "B" batteries, Sterling "B" Battery Charging Attachment, $5.00

THE STERLING MFG. COMPANY
2847 Prospect Ave. Cleveland, Ohio









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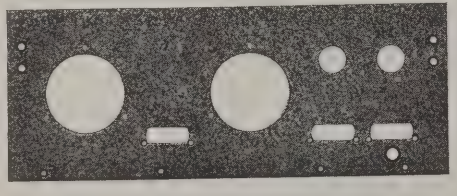
—in a tried and proven circuit, not a "trick" hook-up.

In building a radio set the use of a proper circuit is equally as important as the employment of good parts. The tuned radio frequency circuit, with its manifest advantages, offers the best assurance of lasting satisfaction.

Eisemann parts and panels enable you to build a finished set having the appearance of a factory-made product. Ready cut panels and combination units save half the labor customarily involved.

EISEMANN MAGNETO CORPORATION
38 Thirty-Third Street Brooklyn, N. Y.



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DeLuxe Contact

Na-ald DeLuxe No. 400

NA-ALD

DE LUXE SOCKET

The laminated phosphor bronze contacts of the Na-ald De Luxe Socket press firmly on both the ends and sides of tube prongs, keeping the surface clean and insuring clear reception.
Moulded of genuine Bakelite, this socket expresses the very highest quality in appearance and workmanship.
Write for "Why a Bakelite Socket" for further facts.

Alden Manufacturing Company
Largest makers of Radio sockets and dials in the world.
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By GEORGE J. ELTZ, Jr., E. E., A. I. E. E.

Complete description of each of Three Circuits Invented by MAJOR E. H. ARMSTRONG

52 Pages—21 Photos and Hook ups

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Canadian—2bn, 2cg, (5go), (5cn).
Bowdoin—(WNP).

9EFC—THOMAS D. CUNNINGHAM, Columbia, Missouri.

1aky, 1apc, 1asi, 1aur, 1bdi, 1bhk, 1cm, 1cmp, 1cpi, 1cpn, 1fb, 1jt, 1mo, 1pa, 1sd, 1sn, 1vv, 1yb, 2awf, 2cqz, 2cxl, 2kk, 2om, 2rb, 3abw, 3adv, 3bcn, 3bdo, 3bei, 3bni, 3bnu, 3bwt, 3lp, 3me, 3su, 4ag, 4cs, 4eb, 4eq, (4ku), 4mb, 6aak, 6agk, 6ajd, 6ajf, 6alv, 6ao, 6arb, 6aup, 6avv, 6awt, 6bbc, 6beo, 6bgy, 6bh, 6bjq, 6bpz, 6bql, 6buo, 6cai, 6cbd, 6cbi, 6cek, 6cff, 6cfi, 6cfs, 6cfz, 6cgw, 6chl, 6ckp, 6cu, 6fy, 6hp, 6ii, 6pl, 6rm, 6ts, 6vf, 6xad, 6zr, 6zar, 7abb, 7aek, 7bj, 7cf, 7go, 7hc, 7hw, 7ks, 7lw, 7ly, 7nn, 7oh, 7qj, 7sc, 7sf, 7wm. 7ze, 7zu.

Canadians—2cg, (3ad), 3bg, 3fc, 3gk, 3he, 3in, (3jt), (3ko), (3ni), 3qs, 3xi, 3yh, 3zt, 4cl, 4cn, 4co, 4cr, 4dq, 4er, 4fn, 4hh, 5cn, 5go, 9bx.

Mexican—(bx).

RAYMOND E. GROEBE, Elizabeth, N. J. Heard during November.

All C. W.—1adn, 1aez, 1ahz, 1ain, 1aja, 1ajt, 1ajx, 1akr, 1ali, 1alj, 1amc, 1anb, 1aoc, 1arw, 1atj, 1aur, 1avg, 1awv, 1aww, 1bam, 1bdb, 1bez, 1bgc, 1bgm, 1bhq, 1bma, 1bmf, 1bnf, 1bom, 1boq, 1bsb, 1bsh, 1cav, 1caz, 1cjr, 1ckn, 1cmp, 1cnp, 1cqn, 1crw, 1dqp, 1xam, 1ar, 1cg, 1ez, 1fd, 1gs, 1hw, 1hx, 1jt, 1ka, 1mq, 1my, 1oz, 1rr, 1um, 1vg, 1vv, 1wi, 1xu, 1xz, 1yk, 3aao, 3acq, 3acy, 3aec, 3afq, 3aic, 3aky, 3amw, 3arm, 3ats, 3ava, 3bda, 3bdo, 3bdr, 3bei, 3bgc, 3bgg, 3bjd, 3bkt, 3blc, 3bml, 3bnt, 3bnu, 3bof, 3bsb, 3bta, 3btl, 3bvn, 3bwt, 3cah, 3can, 3cbz, 3ccu, 3cfv, 3cia, 3cio, 3cjn, 3as, 3av, 3bg, 3bq, 3bx, 3do, 3ds, 3eh, 3fb, 3gk, 3ii, 3iy, 3ji, 3kq, 3ld, 3me, 3oq, 3ox, 3pz, 3qm, 3sg, 3su, 3tb, 3uu, 3vw, 3wf, 3zm, 3zo, 3zs, 4ai, 4ay, 4bk, 4bq, 4db, 4du, 4dy, 4eb, 4el, 4eq, 4fs, 4ft, 4hr, 4hz, 4iu, 4jk, 4jz, 4kc, 4ku, 4lj, 4mb, 4me, 4mi, 4my, 4na, 4ob, 4on, 4ou, 4qf, 4rh, 5abd, 5abn, 5abt, 5aby, 5adb, 5adh, 5afs, 5agj, 5air, 5aiu, 5ama, 5amh, 5ams, 5amw, 5zak, 5zas, 5aa, 5ac, 5bw, 5da, 5ek, 5er, 5fv, 5fx, 5gj, 5if, 5jl, 5kg, 5kh, 5kr, 5lr, 5mi, 5mo, 5mw, 5nn, 5ok, 5ph, 5sk, 5uf, 5ui, 5uo, 5up, 5vv, 5wo, 5wx, 5za, 5zb, 5zg, 5zm, 6ajr, 6aol, 6avv, 6bbh, 6bfg, 6bih, 6cbu, 6fp, 6km, 7io, 7ks, 7sf, 7sh, 7ws, 7zd, 7zu, 8aaf, 8aaj, 8abd, 8abe, 8acn, 8act, 8adh, 8aeg, 8afn, 8afu, 8agl, 8agp, 8ahq, 8aig, 8aih, 8aje, 8ajh, 8amn, 8amr, 8amx, 8anb, 8anm, 8anq, 8ard, 8asv, 8atn, 8awl, 8awt, 8azh, 8azj, 8azo, 8bau, 8bbv, 8bci, 8bcu, 8bda, 8bfe, 8bfr, 8bgt, 8bia,

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ASBURY PARK, N. J.
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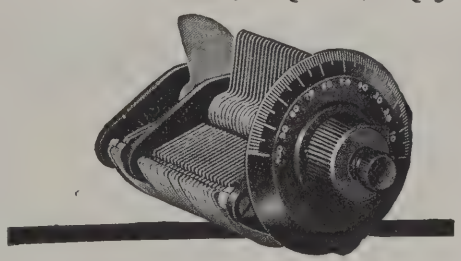
U. S. TOOL COMPANY, INC.
113 Mechanic St., Newark, N. J.



Mr. F. E. Black, Chief Radio Officer, S. S. America—a former student of the Radio Institute of America.

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You may know nothing about radio today, and yet in a few months be holding a position as radio operator—perhaps traveling to places you have always dreamed of seeing. Earning good pay at the same time. And started on a career that holds big future opportunities.

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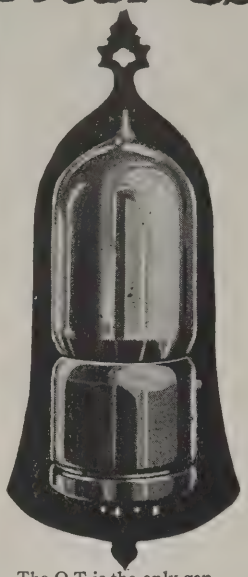
Clear as a Silver Bell



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(Registered)

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sharp, clear, mellow tones—
music with its delightful and thrilling modulations—
speeches without distortion, audible down to a whisper—
and all the other joys of Radio at their best

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Manufactured by DeForest Tel. & Tel. Co.

Exclusively for the

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High class representatives wanted.

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One to four phone connections at one time. Tipped or plain cord ends quickly attached. For use with any standard Jack. Properly insulated; sturdily built; will wear long and well. Now used as standard equipment with leading manufacturers.

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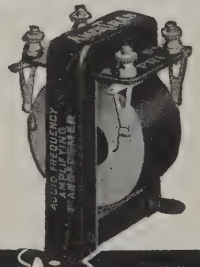

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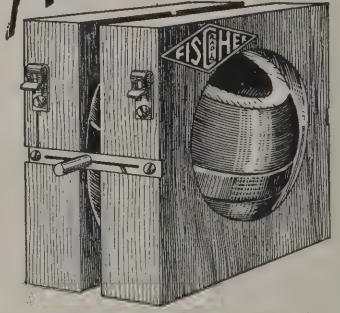
Canadians—1ar, 1dd, 1dq, 1zl, 2am, 2au, 2be, 2bg, 2bn, 2cg, 2ct, 2hg, 2hv, 2ic, 3adn, 3adu, 3ba, 3bm, 3bq, 3bt, 3co, 3ct, 3ep, 3fc, 3fo, 3gk, 3he, 3kg, 3kp, 3lw, 3ni, 3oe, 3pg, 3qs, 3sp, 3tb, 3tf, 3wg, 3xi, 3yh, 4cl. WNP.

Approved!



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Approved because perfectly constructed.
Approved because it has a genuine mahogany stator and a kiln dried rotor.
Approved because of Fahnestock spring clip connections and non-conductive adhesive.
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GET ONE FOR $3.50
20 Diagrams FREE With Each

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THE WIRELESS AGE

"America's Foremost Radiophone Review"

VOLUME XI FEBRUARY, 1924 NUMBER 5

"Why I Became a Radio Fan"

A SYMPOSIUM

The Prize Contest Recently Conducted by THE WIRELESS AGE Was the Cause for the Receipt of a Great Number of Letters Which, Taken Together, Tell Pretty Clearly Why the World Has Become a Radio Fan

IT is a pretty general trait of human nature to want what seems to be giving a lot of other folks a good time. Sometimes we decide that the particular thing that gives some of our acquaintances pleasure may not afford that same pleasure to us. Tastes differ, and capacities differ. Not all the world likes a boxing match, and not all the world enjoys a lecture on bugs. Then, while most of us feel that we could manage to find some pleasure in a steam yacht, there aren't yachts enough to go around, so we quit thinking very much about steam yachts and trips to Europe and being president and such magnificences.

But there was one thing, back in a century that seems long ago, that everyone desired and pretty nearly everyone sooner or later managed to get—that was the bicycle. Remember? What a world of new freedom opened up with the bicycle! And along about the same era came the general extension of the telephone, so that everyone began putting telephones in the home. What a world of new possibilities and convenience opened up with the telephone—and trouble, when sister "gabs" for more than fifteen minutes with her friend, and the butcher can't make out whether it's ham or lamb you want, and Central persists in ringing you up for the "wrong party, excuse me, please!" And then, some years ago, came the automobile. Again a general fever of desire, still more keen and widespread! Still further extension of Everyman's interests and possibilities.

Today it's Radio.

Why I Became A Radio Fan Might be, but IS NOT the Title of this Picture

PRIZE CONTEST ANNOUNCEMENT—WHAT IS THE TITLE FOR THIS PICTURE?

For the best title to this picture submitted before March 31, 1924, THE WIRELESS AGE will give as a FIRST PRIZE—A WIRELESS AGE Reflex Receiver (described in this number). The next best title will receive a Second Prize of Five Dollars. The 3d, 4th and 5th prizes which will be awarded in this contest will be subscriptions to THE WIRELESS AGE. THIS IS FOR YOU! What is this picture about? And what is the snappy title that is needed to give the clue? Send in your suggestion to the Contest Editor, THE WIRELESS AGE. Don't delay.

Only in its beginning, and millions have already responded to its appeal; and because millions have shown how great a thing radio has meant and means to them, and because radio is within the compass of nearly every man, woman and child, still other millions in ever increasing numbers are going to swell the ranks of radio fans.

Why?

Because, like the bicycle, like the telephone, like the automobile and the movie, radio represents to you and to every other chap and to our wives and sweethearts and doddering grand-dads and boisterous sons and still more *boysterous* daughters—a bigger world. A bigger world! Just that.

Of course, some like their bigger world only to be fuller of tinkering and experiment, and some like their bigger world to be only fuller of lectures on bugs, and some want their bigger world to be only fuller of jazz. There's no accounting for taste. But in whatever direction you please, radio does make a bigger world. If you are specially keen about weather, as one of our contestants professes to be, you can have weather from Labrador to the Gulf and ultimately no doubt including the delicious weather that rages around Cape Horn—by the radio. Another writes that he's a radio fan principally because he can go to all the college games—by radio. Still another . . . but there's no need to refer you to the whole long list of eccentricities and hobbies and fancies. Every one of them gets a world of new interest and possibilities, via radio.

"While I listen for just one more"

Yet, withal, there are more souls still that are finding in radio, not one door and one avenue out into a bigger world of one dimension; but many doors and as many diverging avenues into a world of huge dimensions, a world of culture and science and art and pleasure, a world of interesting people and interesting ideas.

And this is why we are becoming a world of radio fans.

Now let's hear from some of our readers who have taken the pains to tell just the why of the individual case.

The First Prize Winner

Arthur N. King, of 12 Dorchester Street, Waltham, Mass., has been awarded the first prize because he wrote:

"I have a boy who wanted a bicycle. That doesn't read like radio, does it? I didn't want him to have a bicycle. The boy then proposed that if I would pay half the cost of a radio set, he would forget the bicycle. We compromised on the radio. I had never heard one! We made our receiver and have listened in from Montreal to Havana, but we want a better set.

"I read six radio magazines regularly and others when I can.

"My ears are flat and my feet get cold while I listen for just one more."

Louise Lorraine is a Sure 'Nuf Fan

There is something that rings very true in this little 100-word letter of Arthur's. And there's a lot between the lines.

Arthur got his bug like a lot of others—from the boy. But it doesn't always come that way. Here's fan-making that comes out of an earlier year and strikes a true note. Its writer, Nelson Nichols, Jr., of Greenlawn, Long Island, has been awarded the second prize:

The Second Prize Winner

"One night in 1916 while copying press from NAA for my brother-in-law, who is not an operator, a peculiar note was heard, and in tuning down the loose-coupler to around 500 meters, we heard "Nearer My God to Thee" being played. At that time broadcasting was unknown, and so uncanny was this music that cold chills ran up and down our backbones, and we sat spellbound and speechless, looking at each other.

"I became a radio fan then and there in earnest, and probably will continue to be one until my time comes to leave this earth of ours."

Blind Fan Wins Prize

The Third Prize has been awarded to Le Roy Drake, of Chicago, Ill., the author of the following:

"I have been blind since infancy. I obtained my graded education from the Illinois School for the Blind at Jacksonville, Ill. I received an advanced musical training; and later I studied and graduated in electrical engineering; and the work of Nikola Tesla led me to the field of radio engineering. I design, construct and operate devices but follow no dogmatic directions. Light is needed in radio work, but much can be done without it.

"Music and radio are inseparable companions; and I try, constantly, to keep posted on both subjects. A good theoretical knowledge of radio is a valuable asset."

Crystal Set Gives First Concert

A genuine and very typical response won the Fourth Prize, for Mary

(*Continued on page* 61)

Mr. Felix Cadou, on the left, has provided radio for the whole family. They have all become fans

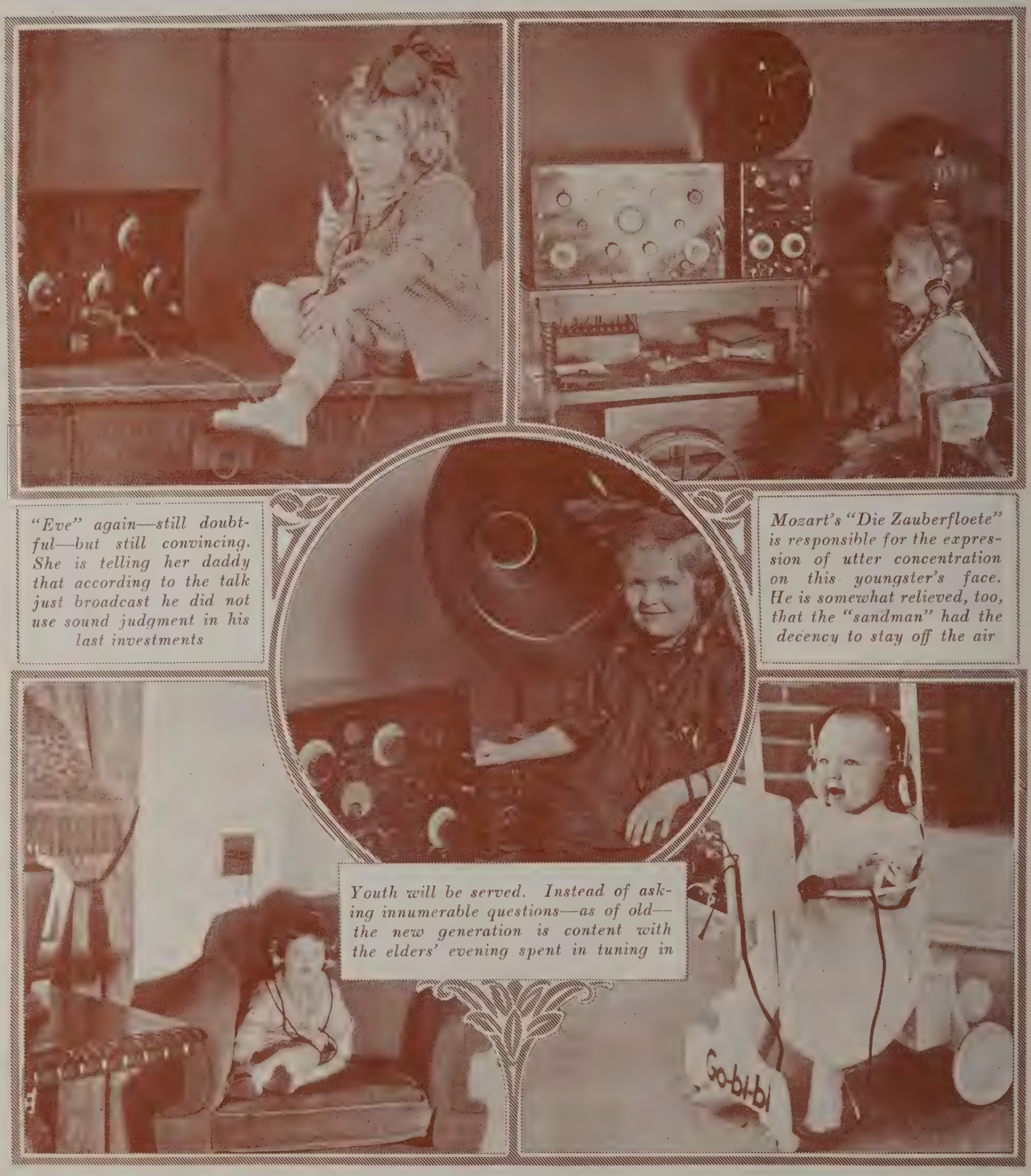
Outstanding Broadcast Features

Rear Admiral Shoemaker, U. S. N., one of the speakers during the Navy Night Programs which are a regular feature of WJZ

Senator Paul Dupuy, publisher of Le Petit Parisien, who broadcast his first spoken message to reach France from America as told on page 27

Just before Mr. Tom Terris gave his second talk on King Tutankhamen's tomb from WOR, Mr. Alfred McCosker showed him a map of the WOR broadcast territory

The Making of B. C. L.'s



"Eve" again—still doubtful—but still convincing. She is telling her daddy that according to the talk just broadcast he did not use sound judgment in his last investments

Mozart's "Die Zauberfloete" is responsible for the expression of utter concentration on this youngster's face. He is somewhat relieved, too, that the "sandman" had the decency to stay off the air

Youth will be served. Instead of asking innumerable questions—as of old—the new generation is content with the elders' evening spent in tuning in

If it's a bed-time story, Brother Rabbit is trying to beat a split-second to cover with the Grizzly Bear rounding the last corner for the home stretch. Incidentally Brother Rabbit doesn't know that a big wolf is waiting in an ambuscade

The little fellow has just stepped out to get the market reports for his mother while she makes up her list of items to be purchased when she goes shopping. Nothing like a little co-operation from all members of the family

Humor, Opera and Jazz, Before the Microphone

Billy Jones and Ernest Hare, famous phonograph humorists, now a regular feature at WEAF. You see them here as they sound on the air

Mabel Corlew, Lyric Soprano, who sang the title rôle in the first Junior Operetta "Little Red Riding Hood," which was broadcast from WJZ

Newcomers to radio—The Brooklyn Mark Strand Little Symphonized Jazz Orchestra and Singers doing their "stuff" to the syncopated rhythm of "feet-shaking" jazz. But we "spilled the beans" on them in "Peeps Into Broadcast Stations." The manager of Station WJY said that they represent the "wildest" moments ever experienced in a broadcast studio

South of the Broadcast Station

"Radio-Canoeing" in Florida — They should worry about February, or, for that matter, about anything else

"Mermaiding" by radio is a new sport on the southern bathing beaches. All we want to know is, when does she dive? Or does she dive?

"Music While You Dine," on that southern trip—now we know the lure of the wide open spaces. The automobiles on Broadway, just now, seem to lack the romance pictured here

And this is adding insult to injury. They use OUR music to play on a Florida beach while WE shiver in New York so that it can be broadcast to them

Another powerful station you must try to tune in to your receiver

"K G O" on the Pacific

The General Electric Company's Pacific Broadcasting Unit

By Earl Ennis

BEDDED in concrete, its giant antennas pointing toward the Orient. and the American continent at its back, the General Electric Company's first permanent broadcasting unit has reared its sentinel towers beside the portals of the Golden Gate on San Francisco Bay—the most recent of the world's great radiophone units.

A sister station to WGY, famous unit at Schenectady, N. Y., it has stepped out of the development class, which was WGY's initial status, into the field of permanency. In Oakland,. Cal., chosen for advantageous location and important purpose, all that has been worked out at Schenectady has been installed to ingenious effect. In its final analysis, the new station may be said to be one of the world's best—the compacted product of many months of experimentation in research and development fields.

The establishment of the new General Electric station comes at a most advantageous period in Pacific Coast radio development. The Pacific has long been one of the world's greatest radio fields. Perfect climatic conditions, astounding magnetic beneficence, and an absence of the terrific static so familiar to Eastern states, have made broadcasting on the West coast a thing of beauty and a joy forever.

Nightly listeners, who sit at their lamps and knobs, reach out to untold distances with ease and surety. They span the Rocky Mountains to Chicago, New York, Atlanta and other far points much easier than do the Eastern listeners working westward. One reason lies in the fact that the West has been lacking in stations highly enough powered to span the 3,000 miles from coast to coast.

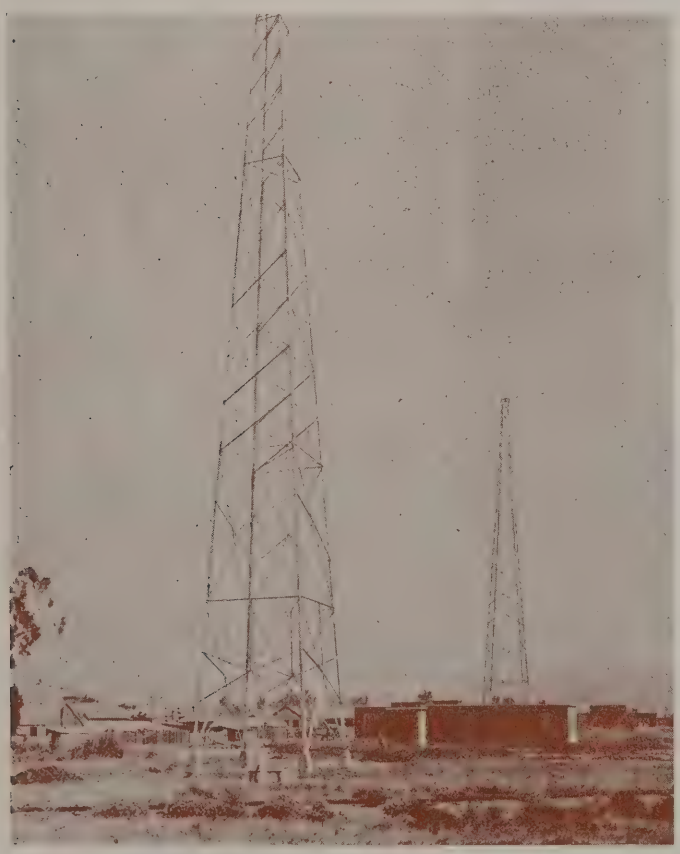
But the past year has seen the coming of standardized equipments. These have carried the fame of California stations to the East. Fragments of weather reports, the singing of canaries in the dead of winter, heard over thousands of miles of intervening space, have turned the ears and attention of the listening Eastern world toward the West. There has grown up out of these nightly pilgrimages through the ether, the hope and expectation that the West would do something for the broadcasting development commensurate with its possibilities.

Martin P. Rice, Director of Broadcasting for the General Electric Company

The new Pacific Coast broadcasting station of the General Electric Company is an answer to this national expectation. Where Oriental trade flows through the western doors of the United States, this new station, one of the most powerful of its kind and type on the globe, will reach out with its invisible fingers, tangent to six nations with its mystic touch. There will be wrought the West's great epic of aerial entertainment and service in strains of music, in tones of the human voice, knocking on a million doors to bring a message of commercial confidence and industrial faith.

The new General Electric station

(*Continued on page* 56)



Antenna, 150 feet high, for the new General Electric Company broadcasting station at Oakland, California. The operating house is shown between the towers.

The studio of the new broadcasting station of the General Electric Company at Oakland, California, which is here shown nearing completion. The first G. E. station, WGY, at Schenectady, has been broadcasting since February, 1922. A third station will probably be built at Denver, Colorado

BROADCASTING *in the* BRITISH ISLES

In England the Struggle to Promote Broadcasting Is on in Full Blast. It is Worth While for America to Watch the Problem Work Out Across the Ocean

By Arthur R. Burrows

Director of Programs, British Broadcasting Company

The Editor of THE WIRELESS AGE has invited me to tell you the story of Broadcasting in the British Isles.

This story, I feel, would have come more appropriately from Mr. J. C. W. Reith, the General Manager of the British Broadcasting Company, for whatever I may say, it is he who has been engaged for over nine months, on a Government Committee and outside it, in fighting battles for radio against odds that would freeze the blood of an ordinary individual. Mr. Reith has fought, and has won, as I am sure his many American friends anticipated. He may not admit what I now suggest, but I imagine his success all along the line in breaking down prejudices and coming straight to the point may be traced in some measure to American influences when during the latter stages of the great war he was engaged in your country upon important work associated with armaments.

Having made this reservation I accept a long-sought opportunity for paying personal tribute to the wonderful pioneer work accomplished for radio by the United States.

While the writer was privileged to conduct long distance broadcasting demonstrations in the North Atlantic, from the C.P.O.S. *"Victorian"* as far back as the summer of 1920, the application of wireless telephony to public uses was not possible in Great Britain until practically the end of last year. British wireless telephones were being sent to all parts of the world, even in hundreds to China, but no practical application was permitted in Britain itself outside the Government Services. This we believe was due to the fact that our country lying on the fringe of an unsettled Europe could not afford to take risks that did not exist in the Western world. So for nearly three years it was our galling experience to have to sit helplessly and watch the striking developments taking place in your country.

Arthurs R. Burrows, Director of Programs, British Broadcasting Company

The time thus spent was not, we believe, altogether lost. There is an old adage over here, that the watchers see most of the game. Rightly or wrongly it was decided that the promiscuous granting of broadcasting licenses practiced in America would lead to disastrous results in the more limited territory of our islands and that however irksome it might be in the first instance to a freedom-loving race it would be good policy when the broadcasting veto was removed to have all stations of any serious power under one central control. Accordingly a British broadcasting company was formed at the end of 1922 which was given a license by the British Postmaster General to establish and operate eight broadcasting stations for a period of two years. The agreement was actually signed in January of this year, but operations on a limited scale under the auspices of a Provisional Committee commenced on November 14th of 1922, three stations then being thrown into service, London 2LO on 369 meters, Manchester 2ZY on 385 meters and Birmingham 5IT on 425 meters. Certain restrictions were imposed regarding the operation and the programs of these stations. No transmission was permitted before 5 P. M. except on Sundays and no news could be broadcast before 7 P. M. By an agreement between the Postmaster General and the representatives of the press all news had to pass through Reuters (who work with the Associated Press of America), who were made a collecting center for news supplied by them and three other recognized agencies.

BRITISH BROADCASTING COMPANY FORMED

The British Broadcasting Company had as its nucleus six big firms intimately associated with the wireless and general electrical industry, the British Thomson Houston Company, General Electric Company, Marconi Wireless Telegraph Company, Metropolitan Vickers, Ltd., Radio Communication Company and the Western Electric Company, all British companies. These

guaranteed the bulk of the capital. All other British firms interested in the radio business were invited to join the company by taking one or more shares and by paying a deposit of fifty pounds ($250.00).

The revenue for the broadcasting programs was to come from two sources. Every possessor of a receiving set was required to pay ten shillings ($2.50) per annum to the Postmaster General for an official permit; of each ten shillings, five were to be handed to the British Broadcasting Company. It was further arranged that except in the case of a limited number of bona fide experimenters, who having proved their purely scientific intent were granted the privilege of making their own apparatus, every would-be listener should buy sets manufactured by members of the British Broadcasting Company and that these sets should carry special royalties (varying according to the number of tubes etc.) which should also be assigned to development and program expenses.

Soon, however, it became apparent that the arrangement was a mistaken one, for as the programs developed and the stations increased in number aerials began to spring up everywhere which obviously were unlicensed, and a run was made upon the retail stocks of component parts originally intended for the pure experimenter. The innate constructive tendency of most healthy British boys asserted itself and passed for the time out of control.

The question of revenue became an acute one and the need for a revision of conditions was soon apparent. A Government Advisory Committee was therefore appointed to deal not only with the peculiar situation of the moment, but to look ahead and examine broadcasting in all its aspects. This committee held numerous sittings throughout the Spring and Summer, sifted a mass of evidence and reported last Fall. Upon this report the Postmaster General has taken action. New conditions have been made for the issue of licenses and a supplementary agreement made between the Post Office and the Broadcasting Company extending the term for which the Company enjoys the license until the last day of 1926. The new agreement permits transmissions at any hour of the day and night subject to Government sanction. It also permits an extension of the original waveband. The new limits are from 300 meters to 439 meters and from 461 meters to 500 meters. The B.B.C. royalties are also revised under this agreement; one shilling (roughly 25 cents) for a crystal set and ten shillings (say two dollars) on a one-tube set, with an extra five shillings for each additional tube.

Miss Ellen Terry broadcasting from the London studio on behalf of the blind.
(Barratts Photo, London)

Antenna system of the British Broadcasting Company's 2LO station which operates on 369 meters

The British License Systems

There are now three forms of licenses for listeners. Firstly a Broadcast license which can only be used in conjunction with a set manufactured by members of the B.B.C. This costs ten shillings annually. Secondly an Experimenter's license, issued to those having a thorough knowledge of wireless, in the hope that they will assist in advancing scientific knowledge. This permits the use of components of any origin, and costs fifteen shillings annually. Thirdly there is a Constructor's license, issued for persons wishing to build apparatus at home. Apparatus constructed under this license must employ British-made components. It may be used for the reception of broadcast telephony, and costs, like the experimenter's license, fifteen shillings annually.

There was a fourth license until the end of October known as the Interim license, intended for those who had constructed sets while the whole broadcasting position was under revision. Over a quarter of a million of these were issued in a few days following the issue of the committee's report.

The Broadcasting Company will receive from the British Post Office seven shillings and sixpence annually from each ten shilling license and twelve shillings and sixpence from each fifteen shilling license.

The immediate result of this change has been such a demand upon the postal organization for new licenses that the period set apart for "roping-in" old defaulters has had to be extended. It is impossible to give actual figures, but the latest returns indicate that the number of licensed listeners in the British Isles is rapidly approaching half a million.

The British Broadcast Stations

The British Broadcasting Company has as its chairman, Lord Gainford an Ex-Postmaster General. Its General Manager, Mr. Reith, to whom I have already referred is by training an engineer, and a man of great versatility. The company's chief engineer is Capt. P. P. Eckersley, one of a devoted band who played a great part in the development of aircraft telephony during the war. Capt. Eckersley is also known throughout the Islands as a fount of spontaneous humor.

The headquarters of the company are in London on the Thames Embankment. This is also the site of the London studio. There are now in Great Britain eight primary transmitting stations, London (2LO) 363 meters; Birmingham (5IT) 423 meters; Manchester (2ZY) 370 meters; Newcastle (5NO) 400 meters; Glasgow (5SC) 415 meters; Aberdeen (6BD) 495 meters; Cardiff (5WA) 353 meters, and Bournemouth (6BM) 385 meters. A relay station on a wavelength of about 300 meters will have been opened at Sheffield by the time this article appears in print.

The transmitting stations have an input of 1½ kilowatts, the relay station being of much smaller rating, roughly 100 watts input. Six of the stations have been designed and erected by Marconi's Wireless Telegraph Company, one by the Radio Communication Company and one by the Western Electric Company. In some of the studios Western Electric microphones are employed. In others, including London, a special transmitter developed by Capt. Round of the Marconi Company is used, employing an exceedingly flat coil of wire suspended to move freely in an intense magnetic field. In only one instance are the studio and transmitting station in close proximity, namely at Manchester. As no station is equipped with duplicate transmitting gear special attention has been given in design to the problem of rapidly interchangeable parts.

The principle of working is to draft at headquarters general rules for the conduct of stations and to leave the provincial station directors to build around these rules special programs of a character known by experience to meet local requirements. It will be obvious to anybody with a knowledge of the British Isles that a program finding favor in Aberdeen for instance, would not give unalloyed pleasure to Bournemouth and district.

Simultaneous Broadcasting

The feature of our system which is likely to create the liveliest interest in America is the simultaneous broadcasting of special events. At six o'clock each evening the British Post Office hands to the British Broadcasting Company direct trunk telephone lines running from the London station to each provincial station. At the London studio there is a distributing board with an array of speech amplifiers and through this board it becomes possible

J. C. W. Reith, General Manager of the British Broadcasting Company. (The Studio photo Sheringham, Norfolk, England)

to connect the London microphone at the same moment to every one of the eight transmitters, or to exchange programs between stations. Manchester for instance, may produce a symphony concert which specially appeals to the listeners in the Newcastle area while at the same moment Cardiff in Wales may be entertaining Aberdeen in the North of Scotland. The two main nightly news bulletins are always radiated simultaneously under control from London and so are also the big London speeches. During the opera season at the Royal Opera House, Covent Garden, London, the simultaneous broadcasting of grand opera as actually performed on the Covent Garden stage will take place on an average two nights a week. Some thousand miles of wire, mostly overhead, are involved in these simultaneous transmissions and some wonderful results have been obtained. Generally speaking there is singularly little distortion in this long distance working, though naturally there are occasional lapses from perfection, due to one of the many risks accompanying the use of long exposed lines of communication.

Experiments have been made in the use of "wired wireless" over the Post Office lines and in the relaying of wireless telephony from one station to another, and it is pretty certain that the latter practice will be employed from time to time for giving to our listeners "pictures in sound" of London by night, the nightingale singing in its natural haunts and one-thousand-and-one other innovations such as will come readily to imaginative minds.

Our programs contain, beyond the usual features, evenings set apart for distinct types of musical programs. A feature of recent programs has been special "Composer" nights when well-known British composers conduct their own compositions. At some stations we have developed programs of particular interest to rural communities. Each station has an advisory committee including representatives of the orthodox religious sects for the selection of Sunday speakers, and at most of the stations there are also advisory committees dealing with special educational features. A very considerable development on the educational side of British broadcasting may be expected.

Opposition to Broadcasting

The development of broadcasting in Great Britain as already indicated, has not been plain sailing. The moment it became apparent that broadcasting had something more than the elements of a passing craze, and that we were taking our task seriously, the entertainment industry began to mobilize its various forces. It naturally was to be expected that detailed attention would have to be paid to the matter of certain "rights," both musical and literary, but the attacks from the theatrical managers and other allied associations were not expected, particularly as we had been approached by several managements with the suggestion that we should broadcast their productions. This we actually did. Following the radiation from London alone of excerpts of three West End plays we had letters from listeners giving the names and addresses of the purchasers of nearly three thousand seats in the more expensive parts of the theaters so broadcast. In the case of one play a listener wrote to state that as the result of the wireless performance he had actually booked twenty-one stalls for himself and friends. The box office of the theater in question confirmed this. Our argument is that the broadcasting of an excerpt from a good play provides for that play the finest possible advertisement. While play bills and the usual paraphernalia of the publicity agent may leave one feeling that in

(*Continued on page* 41)

When Radio Reaches Half a Billion

High Lights of an Impromptu Address Given Recently by David Sarnoff Before the Semi-Annual Convention of the Electrical Supply Jobbers' Association at Buffalo, N.Y.

IT is estimated that, measured in consumer's list price, the American public spent in 1922 between $75,000,000 and $100,000,000 on radio.

On the same basis it is estimated that the American public spent during 1923 at least $150,000,000 on radio, although this figure is probably conservative.

The industry will undoubtedly go on for the next few years virtually doubling in volume each year.

It is a very conservative estimate that 2,000,000 sets are in use in the United States. Multiplying this figure by the size of the average American family, you have a radio audience totaling approximately eight million, and if this business is to double itself each year for the next few years, we may expect 50,000,000 people in the United States using radio.

There are today in operation approximately 450 broadcasting stations in the United States. Of this number, about fifty stations may be regarded as quality stations—that is, those capable of doing a fairly satisfactory job within the present limitations of the art. The other 400 are local stations made up of composite equipment and operated more or less for experimentation, without regular operating schedules.

The present number of stations, 450, merely represents a transient phenomenon in the march of events. Most of these stations will probably go out of business in time. More and more it is evident that the purpose of the broadcast station is to do those things which other agencies cannot do as well or at all. No other agency can speak with a single voice to 10,000,000 people. It is an instrumentality for national events, for high-grade talent, for good music, for good lectures, and the like, and therefore it means that there will be erected in time a number, possibly half a dozen, possibly three, high-powered broadcast stations, suitably located, that may constitute a chain of national broadcasting stations or a national broadcast service, each of these stations simultaneously radiating the same program, whatever it may be, with a power sufficient to reach every city, every town, every village, every hamlet, every home in the United States.

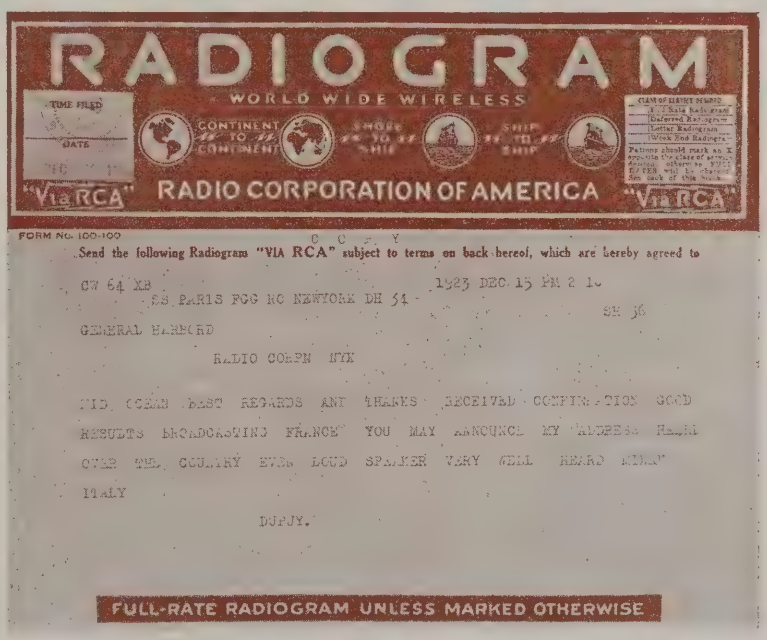
Fortunately for this country, America leads, and has led in radio development, not only in broadcasting, but alike in the matter of trans-oceanic and long-distance communication, and since it is possible to take a high-power station in New York and reradiate its output in California by radio, it is likewise possible to take a high-power station in London and reradiate its output in New York.

Broadcasting can surely be made commercially practicable without any means being found for collecting from the consumer. Just as soon as the freedom and universality of radio is destroyed and confined to only those who pay for it—those who pay for the service—just so soon as broadcasting becomes "narrowcasting" the fundamental of the whole situation is destroyed. And, therefore, broadcasting as constituted today is commercially sound, and will remain so in the future, although there may be selective methods and narrowcast methods which will do no harm.

The General Electric Company, the Westinghouse Electric and Manufacturing Company and the Radio Corporation of America have spent and will spend during the present year approximately $1,500,000 on radio research and equipment.

The Radio Corporation of America alone spent in the neighborhood of a quarter of a million dollars for Station WJZ, on the roof of the Aeolian Hall in New York City. It is costing them many thousand dollars a month to run. They have another one in Washington, D. C., and the General Electric Company will shortly open a station in California and another one somewhere in the Middle West.

Senator Dupuy's Homecoming Delivered to His People in French


RADIOGRAM

WORLD WIDE WIRELESS

"Via RCA" RADIO CORPORATION OF AMERICA "Via RCA"

FORM NO. 100-100 C C Y

Send the following Radiogram "VIA RCA" subject to terms on back hereof, which are hereby agreed to

GW 64 NB 1923 DEC 15 PM 2 10

PS PARIS FOG NC NEWYORK DH 54 SE 36

GENERAL HARBORD

RADIO CORPN NYK

TID COMM BEST REGARDS ANY THANKS RECEIVED CONFIRMATION GOOD RESULTS BROADCASTING FRANCE YOU MAY ANNOUNCE MY ADDRESS HEARD OVER TEL CCUNTRY EVEN LOUD SPEAKER VERY WELL HEARD MILAN ITALY

DUPUY.

FULL-RATE RADIOGRAM UNLESS MARKED OTHERWISE

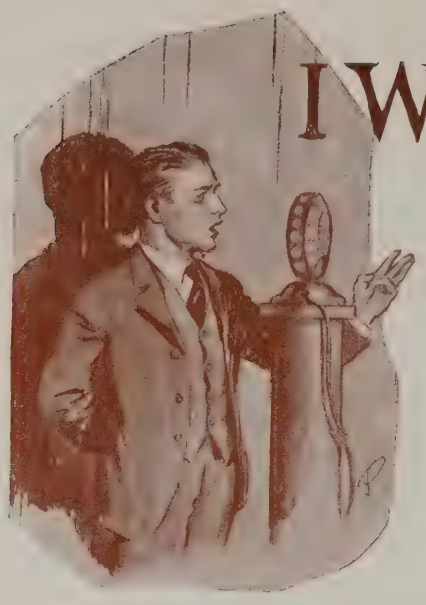
ON the night of December 11, 1923, a voice in New York bridged the Atlantic for eager ears in France. It was Senator Dupuy talking.

Paul Dupuy, a great man in France, a strong figure internationally, stood before the microphone in the studio of WJZ to broadcast a message to the French amateurs. In his native tongue he told them that his investigation of American journalism had been completed, and that he was ready to return home.

Senator Dupuy is the owner of Le Petit Parisien, one of the most influential publications of France. He had come here to study American journals and journalism. His observation of radio development in this country was one of his primary interests and largely formed the text of his message to the French amateurs.

His voice was recognized in Paris, but the words were not distinct. In the rural districts, however, his complete message was received. A report from Milan, Italy, claimed good reception on a loud speaker.

As an expression of his delight with the result, M. Dupuy sent a radiogram to General Harbord from mid-ocean.



"What I have to say is intended for only three men on this continent within reach of this broadcast station"

IWAJ Broadcasting

A Radio Drama of Extensive Action and Interest

By Eric H. Palmer

LOOKING puzzled and yet manifestly much interested, the manager of the broadcasting station arose and addressed the visitor.

"I am very sorry," he informed the tall young man who faced him, "but your request is decidedly out of the ordinary. As I have told you, you are right in the assumption that the privileges of our broadcasting facilities are available under mutually advantageous or otherwise desirable conditions when there is something of interest to the public. In fact, as you know, we have made a number of tests along this line. But your proposition is different. I must submit it higher up. Suppose, then, you let me have a copy of what you intend to say in the ten minutes' time you desire to purchase. You might also let me take the check for one hundred dollars which you have shown me. This will expedite matters. Will you phone me tomorrow morning about 10 o'clock? I hope to have an answer for you."

MYSTERIOUS MESSAGES

Judson Gayne, capitalist with international connections, director of a score of corporations, and philanthropist, was sitting on the porch of his mansion on the North Shore of Long Island, Friday evening, when the butler came forward with a telegram.

"The boy just brought this up from the village, sir," the butler announced.

"Who's wiring me here? Somebody dead?" Gayne exclaimed, hastily tearing the envelope.

A glance through the contents of the message evoked another ejaculation of surprise.

"This is queer; some foolishness, most likely—but I'll do it," he thought aloud. "Thank you, Stevens. Tell the boy there is no answer."

Up in his lodge in the Adirondacks, Harold Dodgworth, millionaire manufacturer and patron of the arts, was summoned to the telephone.

"Telegram for you, sir," spoke the operator at the railroad station ten miles away.

"Wonder what's up! Some crazy idea, maybe, but I'll do it," muttered Dodgworth as he hung up the receiver.

The wireless expert on the yacht bearing Richard Harmstrong, banker and sportsman, saluted and remarked:

"Kind of an unusual message I've picked up for you, sir, if you'll pardon my saying so. They've been trying to get us for some time. Here it is."

Harmstrong read and then laughed.

"Unusual, indeed," he remarked. "But, of course, I'll do it. How the dickens did he know I'd be sailing off Newport today? Here, Anna, look at this, and tell me what's up!"

AN UNUSUAL PROGRAM

It was Saturday night. In all parts of America, in the cities, on the farms, and out on the lakes—and even out on the oceans—thousands upon thousands of people, hundreds of thousands, were listening to the voices and the music in the ether.

Programs of song, talk, and laughter were being given from the studios of a hundred or more broadcasting stations.

Radio fans, everywhere, were manipulating the dials on their sets, thrilling themselves and their associates with the results which carrier waves from far-away cities were bringing to them as if by magic. It was a clear and cool evening. Reception was excellent. Even at an early hour sensitive apparatus in the East was picking up music from Chicago.

But on the North Shore of Long Island, in the Adirondacks, and on the Atlantic off Asbury Park, three men, with their guests, were keeping tuned in with WFFA, one of the newest and most powerful stations in the metropolitan district.

At 9:45 o'clock came the announcement they were waiting to hear.

"This is Station W-F-F-A," a bass voice resounded through the receivers. "The number you have just listened to was 'My Hero,' from 'The Chocolate Soldier,' sung by Miss Ellen Baysden, contralto, of Yonkers. This number concludes her first group of songs. We are delighted to inform you that later on in the program Miss Baysden will be heard again. Station W-F-F-A. One moment, please. . . . This is Station W-F-F-A, New York. Ladies and gentlemen of our radio audience, we now have a special announcement to make. By oral persuasion, more than by any other consideration, a young man has been granted the privilege of addressing the radio audience for a period not exceeding ten minutes, on a subject distinctly personal and hardly in keeping with our regular series of educational lectures. He has especially requested this opportunity tonight. It is not our custom to give permission for a request of this kind, but there are what might be called special circumstances, which I cannot reveal, and we trust you will bear with us, in this one instance, and be interested in what he has to say. The speaker chooses not to permit his name to become publicly known; the reason will become apparent to you in just a moment. He wishes to be designated just by the initials I. W. A. J. We have seen the outline of his message and believe you will be interested. Mr. I. W. A. J."

A strong and appealing voice floated through the air.

"Ladies and gentlemen, I wish that I could do something in which you are probably most interested, sing or tell jokes to you good people, wherever you are," the speaker began, "but I must inform you at the outset that what I have to say tonight is really intended for only three men on this continent, each of whom is within easy reaching distance of this station."

"Now aren't you interested?" the announcer broke in.

"To each of these three men," the speaker continued, "I have dispatched a telegram asking him to listen in. My message in each case was the same, and read as follows: 'You will be rendering a genuine service in encouraging ambition, and perhaps as great a service to yourself, in the final analysis, and to many, many others, if you will listen in to WFFA, Saturday night, shortly after 9.30 o'clock, to hear a message which is intended for you. When you have listened will you kindly send your impressions and reaction to I. W. A. J., care of WFFA.

Signed I. W. A. J.' I trust, therefore, that the distinguished gentlemen in question—for they are distinguished in ability and achievement—(you'll forgive me, won't you, for this allusion—I hope, as I said, that these gentlemen, whom I do not know personally, but whom I admire, are now listening to these remarks.

"Probably the rest of you may be wondering what I am going to tell them. It will be very brief; it will not take all of the ten minutes.

"Now, what does I. W. A. J. stand for 'I want a job.' That is all there is to it. I am advertising through the air for that job. And the men to whom I have telegraphed are the men who have the filling of the kind of position I can occupy in best justice to myself. This job is an exceptional one, calling for certain particular qualifications. I have found it impossible, within the past month, to approach these gentlemen in any other way than through the air—as I would like to approach them. I know that each could use, in this particular and exceptional way, an executive who has a vision for larger accomplishments—if you will not think it amiss for saying this about myself. But I must not let modesty deter me in this—what you might call—this adventure. Your secretaries know all about me, gentlemen. They know my name, and I have taken the liberty of informing them that on Monday or Tuesday they may be asked about I. W. A. J. I have sent each a notice under my name as to what is meant by I. W. A. J. Good evening, gentlemen, and you, ladies and gentlemen of the radio audience, I hope that I have not bored you with this, undoubtedly the first radio application for a position."

"APPLAUSE" MESSAGES

"Well, that chap has some nerve," Judson Gayne said to a party of friends who were listening to the loud speaker. "Do you know, I got one of those telegrams. And that fellow is undoubtedly a live wire. Who else did he send to, I wonder. I think I'll just look him over. Here, you, Billy, call up WFFA on the telephone, and leave a note for I WANT A JOB to be at my office ten o'clock Monday morning."

Harold Dodgworth was talking.

"Operator, I want Radio Station WFFA, New York. How long will it take you?"

Richard Harmstrong turned to his guests and said:

"That fellow had the gall to send one of those telegrams to me, right on the boat. Howard must have told him I was out here. Bates, can you get through a message to WFFA, asking I. W. A. J. to meet me at the bank about three Monday afternoon?"

* * *

The director of the broadcasting at WFFA, at 11 o'clock, beckoned to the visitor who had been sitting quietly in the reception room and stated:

"Here's a telegram."

"From the *Starling;* that's Harmstrong's yacht," exclaimed I. W. A. J. "Just the very word I wanted. Thank you very much."

"No thanks," was the response. "Maybe we'll get the dickens for this. Radio advertising has to be soft-pedaled, you know. But I wish you luck. And, by the way, let me know, won't you?"

THE RADIO ARTIST INTERVIEWED

Harmstrong greeted the newcomer with a smile, and indicated a seat.

"So, Mr. I. W. A. J., you are Donald Russell; or, rather, Mr. Russell, you are I. W. A. J. The name is familiar. Did you ever play football?"

I. W. A. J. nodded.

"Then I remember you," Harmstrong went on genially. "You ran 80 yards to a touchdown on Franklin Field?"

"Were you there, sir?"

"I was—and so was my nephew, whom you bowled over!"

Both laughed.

"Now," the financier declared, "Mr. Howard, my secretary, has been saying a lot of nice things about you."

"You will recall, perhaps, Mr. Harmstrong, that he has mentioned my name to you once or twice, and said it was 'quite special.'"

"Yes, but I have been out of town so persistently that I have made no appointments except for pressing affairs. You know, I can't see a fifth of the people who want to talk with me. How could I be expected to do so? But I am very glad to see you and to have met you—over the radio. You know, I am quite a radio fan. The other night I heard Omaha, but I can't get Frisco yet—can't sit up that late, anyway. But to get down to the matter at hand: I do have an opening for a man of your type—"

Russell interjected:

"Pardon me, Mr. Harmstrong, and thank you again, but I do not want to misrepresent further. That is not the kind of a job I am after, or suited for."

The millionaire looked surprised, and then responded a little sharply:

"Oh, if you don't want—"

"No, offense, sir," said his visitor, with a broad smile. "May I explain?"

Russell's cheery manner smoothed the ruffled feelings of the elder man, who then lit a cigarette, after offering one, leaned back in his chair and advised: "Go ahead."

"Well, you see, Mr. Harmstrong," Russell started. "I have just come from most pleasant meetings with Mr. Gayne and with Mr. Dodgworth, whom you know—intimately. Mr. Dodgworth just returned to town this morning, to see you this evening, too, as he happened to inform me. By the way, I addressed telegrams to them—they are the other two—and they listened in and were courteous to communicate with me."

(*Continued on page* 61)

"Well, that chap has some nerve," Judson Gayne exclaimed to a party of friends listening to the loud speaker

There are Periods in Radio Furniture as in any other kind — Chippendale, Sheraton, Georgian, Jacobean, Gothic and Early American Colonial

Radio Cabinets Through a Lorgnette

Aunt Phoebe's Tour of Radio Furniture

By William A. Hurd

AUNT PHOEBE had written that she was coming East to buy a radio set.

All my fault—I admit it—but I had persuaded her that radio was essential to her elderly, maiden existence only because I needed something to talk about in my letters. Heaven knows I hadn't expected to convert her, to say nothing of prying her loose from the old homestead in Missouri. But that's Aunt Phoebe. When she makes up her mind to do something she does it thoroughly. And coming to New York? Well, when she starts to spend money like that someone might as well prepare for the worst.

This time I knew there was no escape. I had to escort her on one of those dreadful shopping tours.

Having done with the customary display of emotion, so sacred to Aunt Phoebe in all family reunions, we set out to look for an appropriate radio cabinet.

"Something in Early American Colonial," she explained, "would be suitable for the reception room but Hepplewhite would do better for the library. I've been thinking that we might as well have the thing in the library where Martha could play it with less trouble. Martha is getting so old now. Anyway, I think it should go in the library."

Martha is a distant cousin as maidenly, and more prosaic, than Aunt Phoebe, besides having a strong antipathy for new contrivances from which any form of entertainment may be procured.

An enlarged copy of an old Italian Jewel Casket done in dark brown mahogany with Grecian dancing figures in bold relief. It represents the early Italian Renaissance Period

Suspecting that Martha had opposed any such radical notion as buying a radio set, I ventured, "Could it be that you and Martha finally agree on one subject?"

Aunt Phoebe visibly stiffened.

Well, we drifted about the Madison Avenue antique shops, but found nothing appropriate for radio in Hepplewhite cabinets.

At Slum's furniture store on Fifth Avenue, Aunt Phoebe discovered an Italian Renaissance cabinet that stood about four feet high and would just accommodate a good set with loud speaker. It was done in black walnut with hand carved figures in bold relief and a conventional motif.

"It is quite satisfactory," Aunt Phoebe acknowledged, "but I've hardly had enough time to decide."

Understanding perfectly that she meant to see all the cabinets in New York I resigned myself to the inevitable.

In Happyway's, just off the Avenue, the salesman told us that they had discontinued their line of cabinets built specially for radio as everybody preferred period pieces in which they could install the wireless equipment.

We looked at a large assortment of beautiful cabinets, or rather, I should say that Aunt Phoebe examined them. She always seemed to be on the point of scrutinizing an object through a lorgnette.

She discovered Chinese Chippendale, Georgian, Sheraton, William and Mary, and of all things, a Hepplewhite. She's always discovering things.

"The William and Mary cabinet," the salesman insisted, "was the final lot in that period and by all means should be purchased."

"But you appear to concern yourself very little about the periods in which my rooms have been furnished," Aunt Phoebe suggested, "and even though I do say so myself, the best decorator from Chicago arranged the appointments."

This cabinet set is a conventional design done in American walnut. It has an appropriate place with the finest furniture

The inflection of her voice carried a note of finality. I knew she had her mind set on the Hepplewhite cabinet.

"True enough," the salesman explained as he smiled pleasantly. "You see, periods are mixed now. A Georgian piece will be in perfect accord with Early American Colonial or a Chinese Chippendale fits in with Italian Renaissance. Cabinets are especially desirable in any room, including the hall, because they break the line that marks the usual height of most furniture. The only precaution is that bright mahogany doesn't stand next to dull oak. Such contrasts might well be avoided."

Copy of an old Elizabethan cabinet from the days of Sir Walter Raleigh and the Spanish Armada. It is done in oak, weathered finish, and the figures hand carved in bold relief. A conventional motif governs the design of the frieze and drawer-fronts

No use talking, Aunt Phoebe had finally degenerated to martyrdom. Copperweight's, Splint's, and Buckle-Newhat, each of the best houses, as were the others we had visited, confirmed the fact that a cabinet of any period would be suitable for her library.

However, there was no argument against the selection of a radio set built in the cabinet providing, of course, one could be found in good taste.

In Lard and Tallow's, one of New York's finest department stores, Aunt Phoebe was hardly impressed with the offering of sets designed after the conventional upright phonograph. The manager of the radio department courteously explained that the demand for this style had decreased considerably, but that they sold quite a number of the smaller cabinets, splendidly adapted for placing on a table or stand.

From there we took the Fifth Avenue bus uptown and dropped in at Herbs and Brewing. I was astonished to find them bitterly opposed to cabinet sets. The salesman plunged into super-heterodyne and reflex circuits, arguing that people wanted their radio to look like workshop devices. That might do for regular fans, but he made a fatal error when he talked "technical" to Aunt Phoebe.

Working our way through the crowds we stepped into the Manton Electric Company where we were shown the small cabinet sets and a console design which was too low for convenient operating.

A Queen Anne Period done in wax-finished hand rubbed mahogany. The tone chamber is carved from half-inch laminations, kiln dried maple, to eliminate the natural period of vibration in the horn. This cabinet is well adapted to modern furnishings

Finally arriving at Hand-Gripping further on we were ushered upstairs to the showroom. An excellent display of cabinet sets confronted us and the salesman brought out photographs of those not in stock.

Aunt Phoebe was particularly impressed with the artistic manner in which period pieces were unusually arranged to enhance their individuality.

A hand rubbed mahogany cabinet with inlay of satin wood and ebony. The decorative scheme is a blending of modern and period. It is also built as a console cabinet of American walnut with artificially matched panelling. It exemplifies the late Jacobean design

The day over, and Aunt Phoebe perched uncompromisingly on the one really comfortable chair in the living room, the conversation naturally centered on the photographs she had collected during our joyous adventures.

"Well, Aunt Phoebe, since the photographs represent the choice of sets from which you will probably make your selection, what one are you particularly inclined toward?" I asked with a vast amount of dignity well calculated to impress her with the important rôle I had played in this, the big event of her life.

"Dear boy," was her disconcerting reply, "I wish you would put that horrible pipe away. You smoke too much to have a clear mind in performing your duties."

It seemed to me that that was altogether irrelevant. Besides, my effort toward adult patronage had been utterly ruined.

But being something of a stoic, or whatever it is that distinguishes a man of courage, I insisted, "Aunt Phoebe, you have the right idea when you say that radio should be a part of the furnishings rather than a misplaced workshop, but which one of those cabinet sets do you like best?"

She turned the question over in her mind for a long while and then said, "Each one is desirable."

"But which one do you like best?" I still insisted.

"Well," she answered slowly, "the young gentlemen who showed them to us were so obliging I don't wish to be unfair in my choice."

"Yes?" I encouraged.

"So," she finished, "I believe we had better look at all the cabinets again tomorrow."

How To Be A Radio Salesman

By

M. B. Sleeper

Radio Designer and
Technical Publisher

If YOU will practice the rules of the selling game as given in this story of two young radio salesmen, you, too, can sell radio and sell big

Of all the branches of the radio industry, radio salesmanship offers the widest opportunity for the application of originality and personality. He has the wide world from which to draw his "selling" points of interest

ARE you one of those keen experimenters who has become so interested in radio work that you want to take it up as a means of earning your living, and of carving out a future, or the sort who is looking for more interesting work in which there may be a wider opportunity than appears to be ahead in what you are now doing? Have you been thinking about making a salesman's start in the radio business?

If so, you can get a fairly good angle on this kind of work and what it will require of from what follows. I won't attempt to sell you on the idea of putting yourself across as a radio salesman, or discourage you from it. I'll just try to tell you, in a general way, what you'll find it necessary to be, what you'll have to know and do, and what you may get out of it.

This isn't a how-to-succeed-as-a-salesman story, but an account of two young fellows who started at this work, and what happened to them. I'm going to assume that you want to go into this work for all there is in it, either as a stepping-off place to owning a store yourself or as a start toward bigger things which might be in an altogether different kind of business.

After the two big years that the radio industry has had, we find the four sections drawing utterly different development curves. Scientific research has made a steady line upward, manufacturing jumped up, dropped more suddenly, rose waveringly, and is now turning up at a fast rate. The establishment of sound merchandising methods hardly showed above zero until Spring of 1923, when it started slowly up in bumpy fashion, steadying itself slightly this past Fall. The record of radio retailing, however, is a most dismal failure, for practically no progress in developing the art of retail radio selling has been recorded. In fact, the introduction of price cutting as a means of increasing sales should appear negatively, below the zero line.

What does all this mean to you? If you can read between the lines, it means that retail selling, done, after all, by the man behind the counter, owes its increase almost entirely to the demand of the public, created by the appeal of radio itself to the public mind. It means that of all the branches of the radio industry, radio salesmanship offers the widest opportunity for the application of originality and personality.

But let's get back to you and your part in the system of things. Rather than give you a series of do's and dont's, I'm going to tell you about two young chaps who, three years ago, were eighteen years old. They both started out to earn their living at radio when they graduated from high school. They aren't imaginary fellows, invented for your benefit, but real boys whom I know intimately because they came to work for me when they finished school. Before we start with them, however, let me remind you that it isn't necessary to get into a large store in a big city. You may be in the radio department of a hardware store in a town of 25,000 people. There may be other stores there which sell radio, and half a dozen men who build cheap sets to order in their cellar shops. Your opportunity is there just the same, and perhaps a greater chance to develop it.

In the December, 1923, issue of THE WIRELESS AGE, Mr. Pierre Boucheron contributed "Opportunities in Radio Today," in which he told about the six different ways of breaking into the radio game. As there are many thousands of people who are today considering the possibilities of a successful career in the radio field, it is natural that this article by Mr. Boucheron should have received widespread attention. Our readers were promised that THE WIRELESS AGE would publish a series of special articles by well qualified leaders in the radio industry which would develop this subject in detail and inform any reader just how to make a start in any branch of radio. In this month's article Mr. Sleeper, a well-known radio designer, manufacturer and publisher, tells the secrets of RADIO SELLING. His instructions, given in the delightful form of the true experience story, will help everyone who is engaged in radio merchandizing, and will be of invaluable assistance to every person who is new to the business.

If you are interested in this rapidly developing business of radio and want to learn all you can about it from those who have helped to build it up—if you are one of those already in the industry who want to better themselves—still more, if you are one of those thousands who want to find a way to get into radio and contribute to its development—then you must not fail to read these articles on the "Opportunities in Radio Today."

Why One Youngster Failed

Larry Thayer, when he started in behind the counter on the first morning, immediately tore off a piece of wrapping paper, spread himself over the showcase, and, supporting his chin on one hand, apparently continued to dope out a circuit he had been thinking about on the way from home. The first customer, in a hurry to get something as he passed the store on his way to work, had to wait until Larry finished what he was doing before he could get any attention. Meanwhile, he couldn't see the top row of trays in the showcase because Larry was in the way. Then—"Well, old top, what do you want?" It happened that the customer was too much older than Larry to relish such a salutation.

But he patiently explained that he was making a loose coupler, and wanted sliders and rods. Back came Larry, "Oh, that's old stuff. Everyone's using variocouplers nowadays for getting short wave transmitters. Let me show you," and he tore off another piece of wrapping paper on which to draw a sketch of it. Now it happened that the man was employed in a jewelry store, and wanted a tuner for Arlington time signals. There were sliders and rods in the case under Larry's nose.

When the customer said, "No, never mind," and walked out provoked, Larry was offended. He remarked to another clerk that the poor nut didn't have sense enough to take the advice of a fellow who knew the game. Why, he made himself a variocoupler way back in the old days when they only had carborundum detectors! In "those days" he was about nine years old, but

"Well—what do YOU want!" The customer was too much older than Larry to relish such a salutation

that was a matter of detail that didn't count.

Two weeks later, shipments of new stock came piling in, in preparation for the Fall trade, growing rapidly with the establishment of broadcasting. Larry studied each new item until he must have known it inside out. In fact, he didn't have much time to wait on customers. When a man went right up to Larry and said he'd been standing around ten minutes just to get a couple of binding posts, Larry, with a far-away look in his eyes, and an air of being imposed upon would get out the parts, ask rather insolently, "Is that all you want?" make two or three mistakes in the cash slip, and go back to his studies again.

He didn't seem to think that he was employed to sell apparatus and not to look at it. Probably he didn't realize that his customer was offended, that a courteous clerk in another store would sell that man five or ten dollars' worth of the same new parts that we had just put in, or that untidy sales slips are the bane of a bookkeeper's life.

How Petty Theft Develops

Before long, Larry's friends started to turn the store into a smoking room. They hung around for hours, it seemed, telling lies about their sets at as much length and with as much noise as some golfers we know whose main topic is their shots and scores. Pretty soon a few tubes disappeared, followed by meters and other parts. Of course, Larry didn't take them, but he was careless about leaving things out on the counter.

Finally, someone who knew him made a remark about the wonderful radio set that he had, an outfit so elaborate that he couldn't have bought the parts from his weekly wages. One of our boys stopped at his house the next evening, and, sure enough, there were all kinds of things which, as Larry explained, he had taken home to try out. No one wants to have an employee arrested for stealing, but in the radio business, where "borrowing" is so easy and so expensive to the company it is necessary, as an example to the others to secure for the offender the maximum sentence. Because Larry was not of age he went to a reformatory until he was twenty-one.

I shall never forget the words of the policeman who came for him. He said, "If you had had any common sense you'd have known that, no matter how clever you are at doing wrong, there is always some one just a little more clever to find you out."

Most concerns allow employees to take things out on memorandum, or sell them at actual cost, to make stealing unnecessary. Why Larry wasn't satisfied with that I don't know.

How Charlie Made Good

The other boy was Charles Farris. He came up from Fort Worth, Texas, to learn the radio business. He didn't make any pretense of knowing radio. In fact, he had never heard a spark signal, but he thought there were big things ahead in radio and wanted to be in on them. Consequently he started in the packing room where he learned the names of the instruments and picked up a little general knowledge about them.

Quick, willing, cheerful, working rapidly but carefully, he soon graduated to the shop where he assembled sockets, transformers, variometers and what not. He was so interested in learning everything about his work that it was a pleasure to move him around so that he could get the widest experience. At the same time, he kept his

He didn't seem to think that he was employed to sell apparatus

questions for lunch time or after hours at night. He did less talking during the day than any other boy in the shop yet he learned more. The next step was the assembly of sets and wiring, followed by trouble-shooting at the test bench.

In three months' time he was ready for the store. No customer had to wait for Charlie. He was ready with a pleasant "Good morning," and the last customer of the day was greeted with an equally cheerful "Good evening." Charlie's system was simple, though it took mighty good judgment to carry it out. When he first talked with a customer he decided about how much money he had with him. Then he set out to make him spend all of it. That method had to be carried out with discrimination. If a man stopped in to buy a spool of wire and produced a ten-dollar bill it wasn't practicable to sell him ten dollars' worth of goods, as a rule. However, there was always a new magazine or book, a new lot of plugs, a special on variable condensers, or something else which, oftentimes, cost more than the thing that had brought the man into the store. On the other hand I have watched him sell a customer a list of parts so carefully that I wondered why he left him twenty-five cents. And when I asked him, he told me it was a man who lived outside the city, and it cost a quarter for him to get home!

Did those little extra sales—a magazine, some screws, or a package of soldering lugs pay? Charlie's sales

(*Continued on page 74*)

Oberammergau Comes to America Through the Microphone

Age Old Traditions Seek Refuge in Radio

As Told by W. A. H.

ROMANCE in Radio? Well, rather!

Seated comfortably in the parlor of Anton Lang's suite at the Hotel Waldorf-Astoria, our little party exchanged reminiscences of studio lore while we waited to go on the air. Anton Lang was in the next room rehearsing the talk that he would deliver over the microphone to an audience of one million people, an audience remote from Bavaria, the land of privation and suffering. The bits of gossip, long familiar to me, mingling with the muffled roar of the great city below, lulled my thoughts to a passive state of reflection. The microphone, idly engaging my attention, seemed like a crystal globe; fancy shaped into pictures.

A winding road leading over the Bavarian Alps, past the old Monastery of Ettal, drops down to the valley of the Ammer River where Oberammergau nestles in the hollow of picturesque mountains.

A TYPICAL SCENE IN OBERAMMERGAU
The church in the background originally housed the Passion Play

During the reign of Charlemagne the Passion Play was introduced into Germany, gaining a renewed popularity when the Crusades caused a great religious revival. While the Christian World dreamed of retrieving the Holy Land from the Moslems, Oberammergau was founded. And later, following the Thirty Year's War, a pestilence raging through Bavaria reached this little village and claimed so many victims that the entire population was threatened.

On the vigil of the feasts of Saints Simon and Jude, October 27, 1633, the remaining villagers assembled in the churchyard and over the graves of the departed pledged themselves to enact the Passion-tragedy in honor of the bitter sufferings and death of the Lord every tenth year for all time to come.

In the following year the pious promise was fulfilled for the first time. And from father to son down through the generations these people of Oberammergau have kept their faith.

First in the church, later in the churchyard, and finally in an open theater, the Passion Play has been performed on a magnificent scale, the text having been revised in the nineteenth century by the parish priest of the village, the Rev. Father Daisenberger, who devoted his life to the welfare of the Oberammergauers.

The music for the chorus, which explains and connects the various scenes and tableaux, was composed by the village schoolmaster, Rochus Dedler, in 1810.

While our party, consisting of the announcer and operator for WJZ, Dr. Ruederer, a Munich correspondent and member of Herr Lang's party, and a young American of the publicity staff, were waiting for the moment when Herr Lang should give his message over the ether, Dr. Ruederer told us somewhat of the home life of these folk.

Scattered about the church and theater, the houses of Oberammergau, low, substantial structures of stone with the outer walls covered with lime, have painted upon them the various scenes from the life of Christ or the Virgin Mary or some favorite patron saint. Each home contains the workshop of the owner.

The villagers, themselves, are a quiet, simple folk, artisans in the woodcarving craft and painting and pottery, living devout lives to better prepare themselves for their rôles in the Passion Play. Each child hopes for the highest honor known to the Oberammergauers, the part of Christus, accorded to that one who has led the most exemplary life.

Woodcarving is the principal occupation of these villagers, but pottery and painting are an important and highly developed part of their activities. A rigid custom rules that son be

apprenticed to his father, thus maintaining the traditions and excellency of their art.

Early it was conceded that Anton Lang would be chosen for the Christus. He ployed that rôle in 1900 and again in 1910, and probably for the last time, because of his age, in 1922. The latest performance of the Passion Play was delayed two years on account of the great World War.

The war; the suffering following the ravages of that war! My thoughts abruptly came back to the hotel room and the mission that brought the fourteen players from Oberammergau to America.

Anton Lang entered, smiling, a little confused.

Shaking his head slowly, he said, "It doesn't seem possible that a million people can hear me when I talk into that instrument. They have told me that your people will hear me and know of my mission in all parts of the country if I tell them over the radio."

Into the microphone, slowly, passionately, he delivered his plea for the preservation of Oberammergau traditions which his people have so courageously maintained for three hundred years.

He described the work of their hands, their woodcarving and pottery and painting, the schools that were founded for the teaching of these arts, and their plight now that their products are a luxury in Germany and their world markets gone.

They do not raise their own food and it is food they lack. His people face starvation.

Simply, earnestly, he declared their real concern to be for the children who must carry on the traditions of Oberammergau. The older folk, having resigned themselves to the inevitable, look to the future generation for the fulfillment of their ideals.

Anton Lang, the Christus of the Passion Play delivering his first address to America through the microphone which was connected by direct wire to station WJZ. The announcer and operator, at the right, found it difficult to convince Herr Lang that he could actually talk "through the air"

The profits of the Passion Play are used to increase their educational facilities, and the general improvement of the town, but the 1922 performance was a financial failure, adding to the burdens of an already devastated land.

And now the delegation of Oberammergau players have come to America, not for charity, but to sell the products of their labor at the exhibitions to be given over the country.

Having concluded, Anton Lang looked up with the curious twist of his head so characteristic of him.

"I can hardly believe your people have heard me—so many of them," he said, rather plaintively.

Seemingly in answer to his doubt, telephone messages began to come in, and a few moments later, a telegram was rushed to the room. His audience had been there! They had heard!

"Radio is truly a great marvel," Herr Lang replied to my query, "and much more marvelous than in Germany. In my country we don't know so much about these things. I could never talk to such a vast audience there."

Asked if he had been nervous, he answered, "I made some mistakes and it made me feel that perhaps I was not the one to be chosen for a task of such great—" (he referred to his translation dictionary and found the word)—"responsibility."

The American publicity staff member laughed and said to Anton Lang, "Had your talk been any better they'd have thought it was one of us."

"But," protested Anton Lang, "the fate of a stricken people hidden away in the Bavarian Alps might be decided by the message to the Americans through that microphone."

Years of tradition, the fulfillment of an ideal and the faith of a sacred vow hanging in the balance—the weight of a microphone tipping the scales! I wondered if listeners-in realized the dramatic power of broadcasting. Centuries were here spun into a single strand to be woven into a span of a million threads reaching out into American homes.

"Why don't you broadcast the Passion Play?" I asked.

"Never, never," Herr Lang exclaimed, "it is too sacred. We can never commercialize that!"

On the left, Andreas Lang, Sr., in the middle, Anton Lang, and Guido Mayr on the right, putting the finishing touches on some of their carvings and pottery

Little Journeys Into Radio Computations

Some Short Cuts and Interesting Relations in Radio Calculations Told in Practical Illustrations

By Carl Dreher

SOME broadcast listeners are satisfied to hear the music and give no heed to the insides of the receiver. But many of them build their own apparatus and must have some knowledge, at least, of circuits and their functioning. A certain percentage of very hard-boiled BCL's go in for designing sets and working out problems, and for these hardy souls the following article is written. Only the elements of radio computation are taken up, but even so a good many telegraph amateurs, if they will read the article, may discover something new, for many a man who can copy his twenty words per minute does not know why, if he doubles the number of plates in his variable condenser, it will tune to only 1.41 times the former maximum wavelength, while if he doubles the number of turns in the inductance it will tune to twice the wavelength. However, no attempt is made to cover the whole field of radio calculations; instead, attention is called particularly to short cuts and interesting relations through practical illustrations.

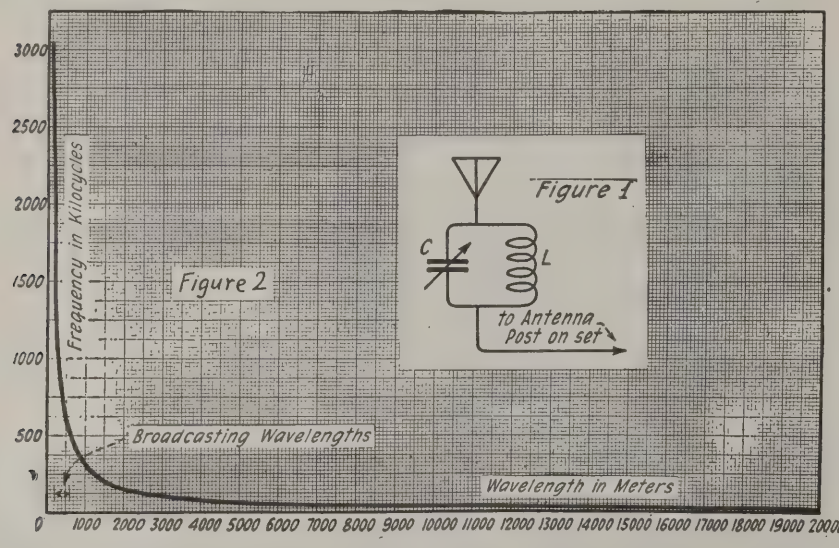


Figure 1—Frequency trap. Figure 2—Chart showing relation of wavelength in meters to frequency in kilo-cycles

Radio is a matter of waves—wavelength and frequency — so the first equation we must consider is the fundamental formula of wave motion. If we have any object—not necessarily an aerial—emitting waves—not necessarily electric waves — we may write

$$\lambda = \frac{v}{n} \qquad (1)$$

where λ is the wavelength, v the velocity or speed of the wave in whatever medium it travels, and in the frequency of vibration of the radiating object.

One should always try to understand a mathematical relation physically and concretely if possible. In the case of an antenna, for example, we have an alternating current of very high frequency. For every oscillation of this current a disturbance or wave starts out from the antenna with a speed of 300 million meters, or 186,000 miles, per second. If the antenna belongs to a broadcasting station, there may be one million such oscillations, and the same number of waves, every second. A wave starts out into space, and a millionth of a second later the next wave sets out in pursuit. The first wave by this time has traveled 300 meters. Hence we see that the wavelength corresponding to a frequency—n in the above equation—of 1,000,000 oscillations per second, is 300 meters. This is a good constant to remember for mental computations. By means of the formula we can readily calculate the wavelength corresponding to any frequency, or the frequency corresponding to any wavelength. The two have an inverse relationship. As one grows, the other diminishes. Thus, while 300 meters corresponds to one million oscillations or cycles per second, the ship communication wavelength, 600 meters, has only half a million oscillations per second; 6,000 meters, which is used for medium high power communication over considerable distances, rates only 50,000 cycles per second; and if we now double the wavelength and get into the band of high power transoceanic communication, we find that 12,000 meters corresponds to 25,000 cycles per second.

As we have seen, 600 meters is the wavelength of a 500,000-cycle oscillation. Or we may speak of 500 kilocycles, a kilocycle being 1,000 cycles. Turning the figures upside down, 500 meters is the wavelength corresponding to 600 kilocycles per second. Halfway between the lines cross; 550 meters have the same number of kilocycles.*

The constant v in the wavelength-frequency equation is, as stated, 300 million meters, or 186,000 miles, per second, for light or electric waves. That seems fast, but it is really none too fast, for as H. S. Osborne points out in his paper "Telephone Transmission over Long Distances" in the Journal of the A.I.E.E., October, 1923, if electricity traveled with only the speed of sound, that is, if v were only 1,100 feet per second—it would take seven hours for a word to travel from California to Cuba, as in the recent 5,500-mile demonstration between Catalina Island and Havana. Actually it takes less than one-tenth of a second, even though the voice currents on a telephone line travel a little slower than radio waves, so that there is nothing to worry about. However, as Mr. Osborne says, "This emphasizes the necessity for using electrical means for the transmission of speech over great distances." It would hardly do to make some sweet remark to a girl on the other side of the continent, and have the answer come back fourteen hours later; she would be too old by the end of the conversation.

At present the tendency is to classify stations not by wavelength, but by frequency, and to speak of kilocycles instead of meters. This is because tuning depends on kilocycles, and while a separation of two kilocycles between two stations corresponds to only a few meters at the higher frequencies, at the lower frequencies it amounts to several thousand meters. Thus if one talks in meters the effect is confusing, for it is hard to understand why a station on 597 meters is no harder to tune out on 600 meters, than a 25,000 meter station on 30,000 meters. The fact is that in dealing in kilocycles we remain in the field of electrical circuits, wher-

*The precise figure is 547.6 based on the true value of v which is 299,820,000 instead of 300,000,000 as generally used.

as when we speak in terms of wavelength the constant v is introduced, so that the move to allocate stations to certain frequency bands is in the direction of purely electrical calculation and discussion, in place of the foreign though connected element of linear measurement. However, as we are now used to thinking in terms of the old arrangement, it will take some time to swing over to the more logical treatment proposed by the Second National Radio Conference.

Having now seen the relationship between wavelength and frequency, we may discuss the factors which determine the frequency in electrical circuits. These are inductance and capacity, provided by the familiar coils and condensers of radio apparatus. In such an oscillating circuit the energy changes rapidly from the electrostatic to the electromagnetic state, being stored up first in the condenser, then in the coil, and alternating continually from one to the other. The number of times per second that this change occurs is the frequency—the quantity n in the fundamental equation. If we call the inductance L and the capacity C, we can readily see that as these quantities grow larger, the energy will necessarily take longer to move from its capacity residence to its inductive residence, just as it would take longer to move the furnishings out of a large house rather than a small one. The frequency, therefore, varies in some inverse ratio to the inductance and capacity. The actual relationship is

$$n = \frac{1}{2\pi\sqrt{LC}} \qquad (2)$$

If this value of n is substituted in the equation (1) in order to get the wavelength in terms of the inductance and capacity, we obtain

$$\lambda = 2\pi v\sqrt{LC} \qquad (3)$$

But this is not in a form suitable for computation. For this purpose the equation may be resolved into the form

$$L = 0.281\,\frac{\lambda^2}{C} \qquad (4)$$

In (4) λ is in meters, L in microhenries, C in micro-microfarads, these being practical quantities used in radio designing. L and C may thus be chosen for any desired wavelength. In practice, the wavelength is known, some value of either L or C is chosen, and the other quantity is then calculated.

Suppose, for example, that we are designing a frequency trap, in the form of a simple resonant circuit, as shown in figure 1, placed in the antenna lead. It is desired to trap out amateur signals only, so that the upper limit need not be over 300 meters. A 23-plate variable condenser is available. Of course 23 plates as a rating of capacity does not mean much, but the usual capacity of such a condenser is 500 mmfd. Substituting 300 meters and 500 mmfd. in their proper places in equation (4), we find that the necessary inductance is a little over 50 microhenries. A spiderweb coil with an inside diameter of 1¾ inches, wound with 25 turns of No. 22 S.C.C. wire, will serve the purpose.

The calculation of inductance is not within the scope of this article, which is intended only as an introduction to the subject of radio computations. It may be mentioned, however, that the best formula for cases where ordinary accuracy is sufficient, is that of Lorenz, given on page 41 of "Formulae and Tables for the Calculation of Mutual and Self-Inductance," by Edward B. Rosa and Louis Cohen, Reprint No. 93 of the Bureau of Standards. This formula applies to single layer cylindrical coils of any practical length, and is given in the simple form

$$L = a\,n^2\,Q \qquad (5)$$

where a is the radius of the solenoid in centimeters, n the total number of turns in the coil, and Q is a factor depending on the ratio of the diameter of the winding to its length; the value of Q for various values of this ratio is given in an accompanying table.

For formulas dealing with special forms of inductance, such as spirals and multi-layer coils, the reader is referred to Circular No. 74 of the Bureau of Standards, "Radio Instruments and Measurements," now out of print as a government publication, but obtainable in book form from the Wireless Press. While these equations are more complicated than (5) above, they are all simple algebraic expressions and no special skill is required to use them, although familiarity with the slide rule certainly reduces the labor involved.

One important rule should be noted in regard to the characteristics of inductances. With any given shape or form of coil the inductance varies, in general, with the square of the number of turns. Doubling the number of turns, that is, gives four times the inductance; tripling the number of turns multiplies the inductance by nine; and so on. Now, equation (4) involving wavelength, inductance, and capacity, may be re-written in the form

$$\lambda^2 = \frac{L\,C}{0.281} \qquad (6)$$

or

$$\lambda = \frac{\sqrt{L\,C}}{0.53} \qquad (7)$$

or, roughly,

$$\lambda = 2\sqrt{L\,C} \qquad (8)$$

(*Continued on page 76*)

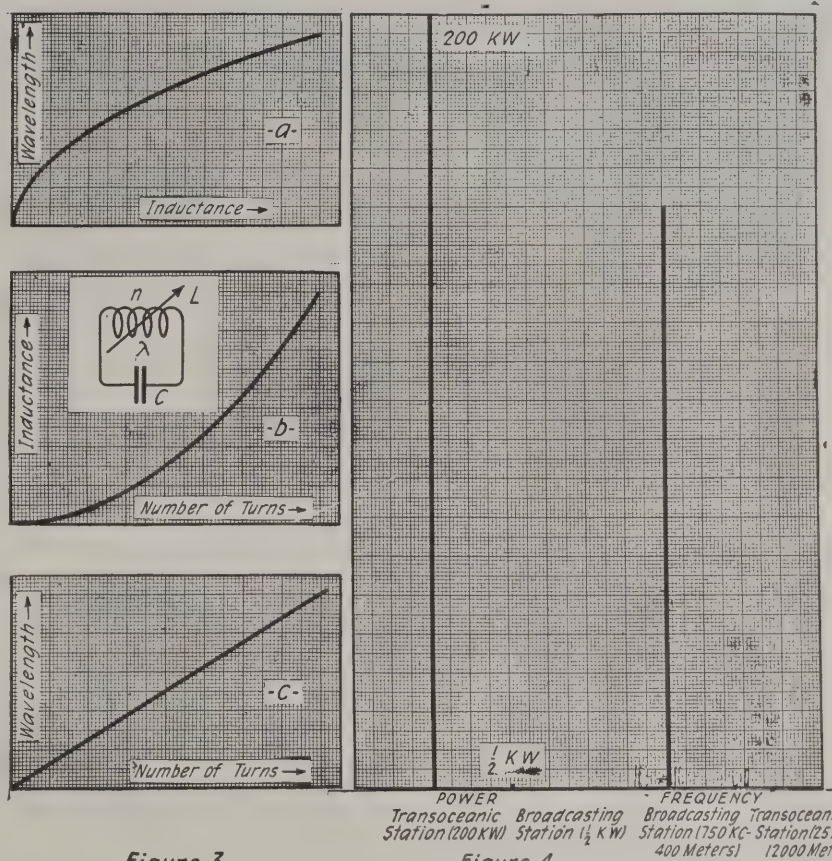


Figure 3

Figure 4

Figure 3—(a) Shows variation of wavelength with inductance, capacity being fixed. The curve is first steep and then flattens out. In (b) the concavity of the curve is opposite, the steepness increasing with the number of turns. These two forms neutralize each other so that, as shown in (c) wavelength increases linearly with the turns if C is constant. Figure 4—Comparison of transoceanic and broadcasting stations' power and frequency

Aladdin's Magic Lamp

There Is No Magic in Any Lamp as in the Radio Bulb

By Jerome W. Howe

THE Arabian Nights! How we have thrilled at these strange Oriental tales that, more than any other stories in the world, have satisfied youth's boundless capacity for imagination and belief! And of the whole collection of fanciful romances which has been aptly called a great three-decker to carry tired people—tired big people no less than tired little people—to Islands of the Blest, what is more often retold and more clearly remembered than the story of Aladdin and his wonderful magic lamp?

With but the mention of the tale it all comes back to us—how the wicked but potent magician came out of Africa to China and used a poor, shiftless, good-for-nothing orphan tailor's son, Aladdin, as a means to get into his possession a wonderful magic lamp which was to be found in a remarkable cave without an entrance deep under the ground; how the magician caused the earth to break away and disclose the cavern into which he dispatched Aladdin after the lamp; and how Aladdin suffered the magician's anger at nearly the price of his life.

But Aladdin came through the ordeal as do most of the heroes of the stories we love, and remained the lucky possessor of the magic lamp.

That magic lamp and its gigantic genie who appeared whenever Aladdin rubbed its surface—what indescribable wonders it worked! You remember, of course, how it provided Aladdin with rich feasts, and brought him a glorious, lovely princess, and how it provided troops of slaves with costly gifts, and, finally, how it transported a whole palace from China to the middle of far-away Africa and brought it back again. Wonderful magic lamp!

But no more space can be spared here for such pleasant reminiscence, for the purpose here is to tell about another magic lamp, discovered centuries and centuries after this old brass oil-burner of Aladdin's, and not in ancient China, but in twentieth-century England and America. And this modern magic lamp, too, can provide feasts and undreamed-of pleasures, and transports on an instant the wonders of far-away places to our very hearths.

Yet there is a great thing about this modern magic lamp that cannot be said of its ancient prototype. There was only one Aladdin recorded by the "Arabian Nights." Today we may all of us be Aladdins and possess a magic lamp, not the least bit less potent and mysterious and wonderful than the old hand-rubbed article of mythological ages ago.

Aladdin's lamp was not found in a day. The African Magician spent forty years in experimenting with enchantments, so the story runs, and after a successful operation of geomancy, whatever that may be, he learned of the existence and location of the marvelous lamp. Then ensued the long difficult travel from Africa to Aladdin's home, and finally the thrilling adventure of the subterranean cavern.

The modern magic lamp was, likewise, the product of long years of patient investigation which led to the development of a two-element tube from which the air was evacuated. An English scientist, Dr. H. A. Fleming, was the first to apply this "valve," as it was termed, to the reception of radio waves. This was in 1904. This tube acted like a valve because it permitted the currents of electricity to flow only in one direction. It thus rectified them into a pulsating direct current, which was then effective in actuating the diaphragms of the telephone receiver.

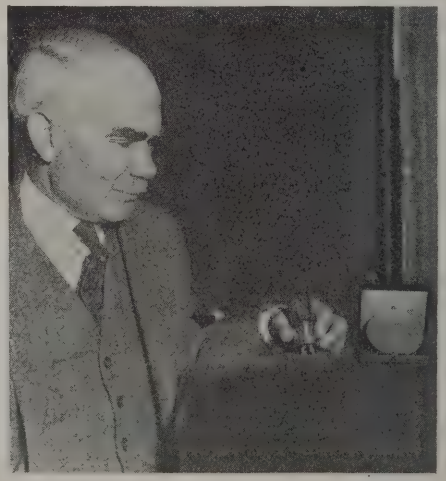
Soon after Fleming's application of this "valve," as the English still call it, to radio, Lee DeForest, in the United States, developing Fleming's discovery, added a very important feature, the grid, which gave us a three-electrode "audion" in which the grid served to control the current passing between the plate and the filament. This was an important step in the development of the new "magic lamp," but still the "genie" was not the sort of chap who, like Aladdin's, could be always depended upon.

This early tube was rather erratic, and sometimes it worked and sometimes it didn't. But it afforded sufficient proof of the possibilities of the vacuum tube to cause the great electrical companies of America to take up its exhaustive and extensive study. And so was perfected in course of time the wonderful vacuum tube as we know it today.

It was found that the vacuum tube was effective not only as a detector in the reception of radio waves, but also as an oscillator to produce radio waves in the transmitting apparatus; so it has come about that the vacuum tube is the primary element upon which radio depends, and when we consider all the wonderful results today that came from radio communication and radio broadcasting, it is apparent that the little vacuum tube is a veritable Aladdin's magic lamp.

The ancient Aladdin had only to rub his lamp; the present-day Aladdin must have a little knowledge about his lamp in order to get the best service from its "genie," and so I am presenting here a brief description of the different kinds of vacuum tubes, their various characteristics and some notes regarding the proper use of them.

The chart on the opposite page contains data on the proper plate, grid and filament voltages for the "UV" and



Dr. Lee DeForest with the medal and the tube that won it

"C" and "WD" tubes commonly used in receiving sets.

As there is very little current flowing in the grid circuit, the "C" battery will last about as long as it would normally last when not in use.

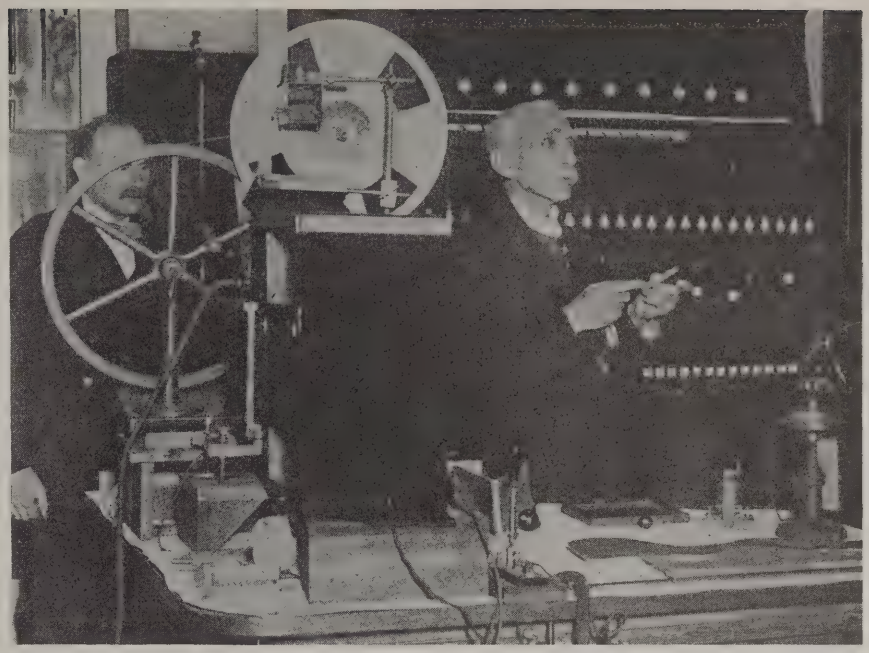
In using vacuum tubes, one should always closely adhere to the manufacturer's specifications as to the proper voltages best suited for that particular tube. One should be very careful not to apply excessive voltage to the filament terminals, as this is quite disastrous, as the filament will either burn out or be so injured that the operating life of the tube will be shortened considerably.

In general, the selection of vacuum tubes depends upon the type of battery available for filament heating. If only dry cells are to be used, our choice is necessarily limited to vacuum tubes of the dry-cell type; that is, those of such construction that the filament consumes but little current; permitting use of dry cells for a comparatively long period.

Of the dry cell tubes, the UV-199 (C-199), the WD-11 and 12, there is little difference as far as actual results are concerned. However, the UV-199 is especially suited for amplification in untuned transformer, choke-coil or resistance coupled radio frequency amplifiers, as it has a low capacity between the plate, grid and filament electrodes; furthermore, the fact that the filament current is so small (.06 of an ampere) makes this tube preferable to the WD tubes.

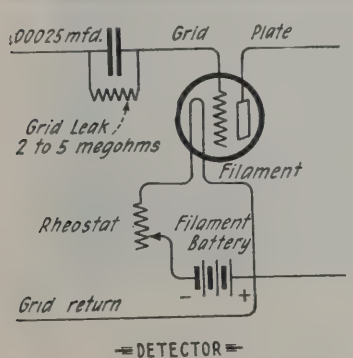
There is no necessity of critical regulation of the plate or filament

(*Continued on page 70*)



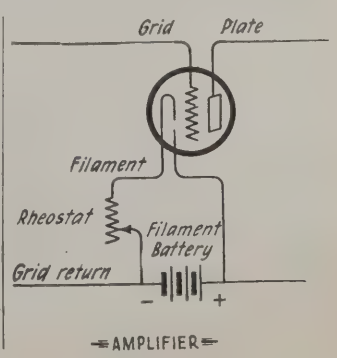
Professor J. A. Fleming holds lectures for children at the Royal Institution on electric waves and wireless telephony

Tube	Filament Battery Voltage	Max. Rheostat Resistance Ohms	Filament Terminal Voltage	Filament Current	Plate Voltage	Plate Impedance in Ohms	Amplification Constant (Approx.)	Mutual Conductance in mmhos.	OPERATION		
									As an Audio Freq. Amplifier	As a Detector	As a Radio Freq. Amplifier
WD 11 WD 12	1.5	4 to 6	1.1	0.25	40 to 100	19,000 at 40 Volts 17,000 at 80 Volts	6.5	340	Fair	Good	Good
UV–199 C –299	4.5	30	3.0	0.06	40 to 60	18,500 at 40 Volts at Zero Grid 16,000 at 80 Volts with 4.5 Negative Grid	6.25	340	Fair	Good	Splendid with either Tuned or Untuned Intertube Coupling
UV–201–A C –301–A	6.0	6 to 10	5.0	.025	40 to 120	16,500 at 40 Volts at Zero Grid 12,500 at 100 Volts with 6 Negative Grid	8	485	Exceptionally Good	Very Good Next to UV–200; Use 15 Ohm Rheostat—45 to 60V B Battery	Excellent with Tuned Intertube Coupling; Not so Good with Untuned Coupling
UV–200 C –300	6.0	4 to 6	5.0	1.00	15 to 23.5	9,000	.....	.....	Good for Code but not so Good for Telephony	Excellent	.....
UV–201 C –301	6.0	4 to 6	5.2	1.00	40 to 120	18,000	7.5	440	Very Good	Fair	.....
WE–"J" VT –1	4.0	2 to 4	2.6	1.2	40 to 100	18,000	6.5	360	Good	Very Good	.....
UV–202	10	1.5 to 3	7.5	2.35	350	5000 at 350 Volts Zero Grid	7.5	1500	Excellent	.....	.....



GRID OR "C" BATTERY VALUE

UV–201–A C–301–A		WD 11 and WD 12		UV–199 C–299	
Plate Voltage	Negative Grid Bias Voltage or "C" Battery	Plate Voltage	Negative Grid Bias Voltage or "C" Battery	Plate Voltage	Negative Grid Bias Voltage or "C" Battery
40	0.5 to 1.0	.....	.....	.....	.....
60	1.0 to 3.0	45	0	40	0.5 to 1.0
80	3.0 to 4.5	60	1.5	60	1.0 to 3.0
100	4.5 to 6.0	80 to 100	3.0	80	4.5 to 6.0
120	6.0 to 9.0	.....	.....	100	6.0 to 7.5



Design of Loop Antenna

Part I

How One Can Easily Obtain the Correct Dimensions to Use Without Mathematical Computations

By Ralph Batcher, E.E.

Author "Prepared Radio Measurements" Wireless Press

WITH the increasing use of radio frequency amplification and the desire on the part of many amateurs to avoid cumbersome outdoor aerials, loops of all sizes and shapes have gained an increasing popularity. However, there is a distinct lack of practical information on the design of this type of antenna. To fill this need a series of three articles will be published in THE WIRELESS AGE and a study of them will enable any amateur to design and construct his own loop for broadcast and amateur reception. The series of articles will treat the subject in an easy-to-understand, non-mathematical way, including the determination of the value of inductance necessary and how to make the loop to obtain this value; mechanical considerations and finally, signal strength with loops and a discussion of their directional properties.

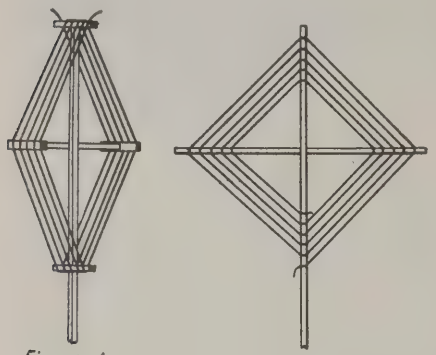


Figure 1 Figure 2

Box and plane type of loop antenna

Before the mechanical design can be taken up, the electrical design must be first considered. The common method of tuning a loop antenna is to shunt a variable condenser across its terminals. This condenser should be the best obtainable and should be selected as one having the greatest maximum-minimum capacity ratio possible. A condenser with this ratio equal to 10 will in most cases give a wavelength range not much over 2—that is, the minimum wavelength receivable will be around half the maximum. To thoroughly cover the broadcasting wavelengths a higher wavelength ratio is generally desirable, so a variable condenser with a capacity radio of around 30 should be selected.

In selecting a condenser it is also preferable to use one with a small maximum capacity. In this way more turns may be used on the loop and a greater signal strength obtained. It is to be remembered, however, that in most cases the smaller the condenser the smaller the capacity ratio. In most cases for the broadcasting range an .0005 mfd. condenser may be used.

After selecting a condenser and determining the maximum wavelength desired the following table may be used to determine the inductance value which must be supplied by the loop:

MAX. INDUCTANCE DETERMINATION

Max. λ =	300	400	500	600	1000	2000	3000	Meters
Cap. = .0004	63.2	113	175	250	700	2800	6350	
.0005	50.5	90	140	200	560	2250	5000	Micro-
.001	25.	45	70	100	280	1120	2530	henries
.0015	17.	30	47	67	187	750	1700	

Or if desired the formula

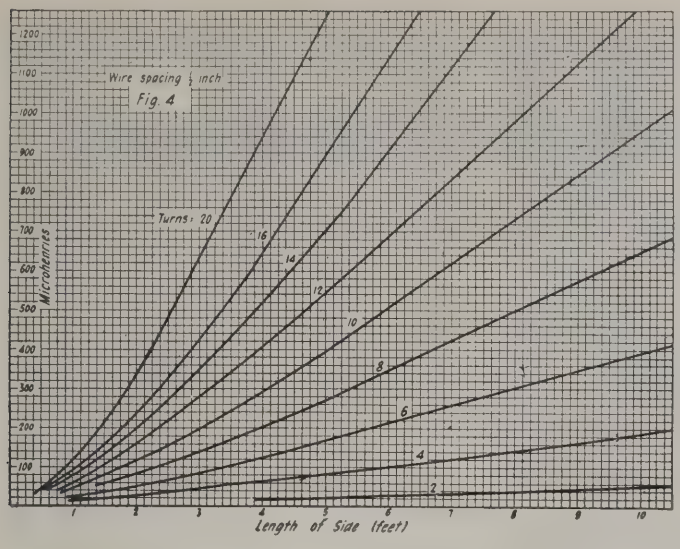
$$L = \frac{\lambda^2}{3600\,C}$$

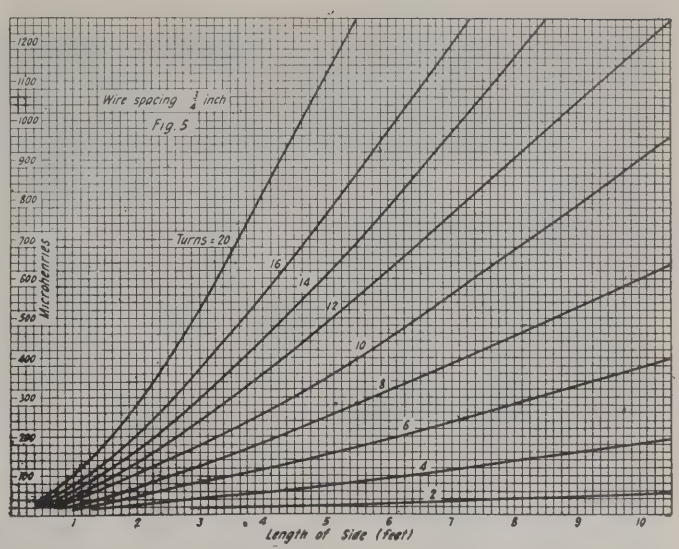
or any other of the standard and common methods can be used.

There are two general types of loop antenna in common use: (A) the box type (figure 1) where all turns have the same dimensions, and (B) the plane type (figure 2) with all turns in the same plane and with the center turns smaller than the outer turns. Of the two types using the length of the outer turn as a basis of comparison, the former is a little more efficient in most cases although the difference is not great. This is due to the fact that it has a little less distributed capacity and has a larger inductance and a larger area per turn, while the former type has a somewhat neater appearance and is generally easier to construct.

The following charts will enable the proper size and turns to be selected for the desired inductance. The specifications in these charts are especially pre-

This novel indoor loop antenna consists of wire sewn to an ordinary window shade. Designed by W. H. Bullock





Graphs giving constructional data for design of inductance coils

pared for loops shown as type A. (But it will be shown later that the same data applies to type B if the value "a" is taken equal to the length of the average turn divided by 4.)

The data applies only to square loops with the wires spaced ¼, ½ or ¾ inch apart. It makes no difference how the loop is mounted (whether the sides are vertical or oblique), either in the matter of the resulting inductance or in the matter of the received energy. If the loop is used near metallic or plaster walls or metal pipes, both the inductance and received energy values are affected.

Three sets of curves are shown from which the inductance of any number of turns and size of loop may be read, for the ordinary range of values used in receiving loops. These curves are based on actual measurements on a series of loops, the data being hitherto unpublished. The wire used was the equivalent of No. 14 B. and S. gauge. The values have been checked and the accuracy should be within 10%, depending on the care taken in interpolation.

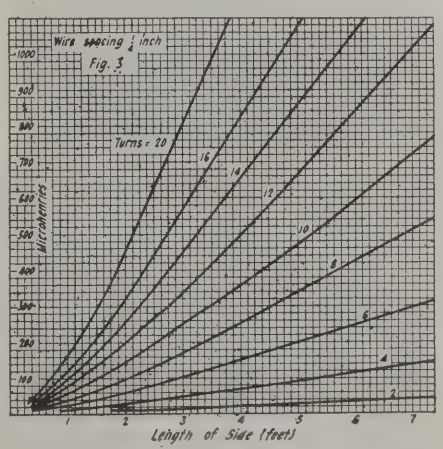
Two theoretical formulas have been published from which the inductance of a loop may be computed, but each is more or less involved for rapid computations. The first may be found in *Jarb. Drahtlose T. & T.*, page 276, in Vol. 1919, by A. Esau. Practical tables are included there for the determination of the constants. The second is shown as Formula 165 in Bulletin No. 74 of the Bureau of Standards. These publications should be referred to in case the theoretical inductance is desired.

In any loop constructed for the ordinary broadcasting wavelengths it is advisable to space the wires at least ¼ inch or more if practical. The spacing in practical cases depends upon the number of turns, since a large number of turns with large spacing gives a loop which may be cumbersome to handle. The spacing should therefore be as large as convenient consistent with practical loop dimensions.

From an inspection of the curves in figures 4, 5 and 6 it will be seen that the desired inductance can be obtained from a number of different combinations of turns, spacing and loop dimensions. All factors considered, except appearance and room space, it is desirable to build a large loop with few turns rather than a smaller loop with a greater number of turns. The reasons will be taken up in a following chapter.

From the above outline it will be seen that all the factors in loop construction can be selected to suit the builder's convenience, except one, but that one must be carefully computed. These factors are:

1. Maximum wavelength desired.



Graph for constructing inductance coil having one-quarter-inch wire spacing

2. Maximum capacity of variable condenser.
3. Spacing of wires.
4. Length of side of square of the loop.
5. Number of turns.

If the values for four of these factors are picked out, the fifth can be readily solved by use of the table and the charts.

The next instalment will deal with mechanical features of loop construction, and the final instalment will take up the theoretical considerations, directional properties, etc.

The second article of this series by Ralph Batcher will appear in an early issue of THE WIRELESS AGE.

Broadcasting in the British Isles

(*Continued from page 26*)

the purchase of tickets there is the element of a gamble, wireless gives to the individual an opportunity for sampling the play and backing his own judgment.

Certain theatrical managers searching around for further arguments against the broadcasting of plays have suggested that great damage might be done by the broadcasting of a play which, although most successful on the stage, has not the essentials for a radio triumph. This is a dubious reflection on those responsible for the broadcast programs. No play would be scheduled for broadcasting that had not been thoroughly tested out with a microphone on the stage and headphones at some remote point.

Happily every management has not taken up this hostile attitude and we are still able to broadcast from actual playhouses grand opera, Shakespeare and non-musical modern plays. We are making arrangements to perform actually in our own studios plays of the character now denied to us elsewhere, and feel confident that in having a free hand for the development of that special technique of translating action in terms of sound we shall probably produce more entertaining results than would be possible if we relied solely on the theatrical managers' assistance.

(*Continued on page 67*)

Peeps into Broadcast Stations

Voice Doesn't Work Well on Soft Carpet

"SCANDAL? . . . Scandal enough!"

Thus was Mr. Felix's reply to our request for some "peeps" behind the scenes at the studio. He happens to be the publicity manager and "trouble shooter" of WEAF.

"Listen," he continued, "why don't you write a story about the trials and tribulations of a broadcast studio personnel?

"For instance, we have artists scheduled for the air who send their photos, demanding that we get them in print, which we certainly try to do, but failing, they threaten to cancel their dates. And, mind you, after we have released our programs to the papers.

"On one occasion, a brilliant artist, due to go on the air, stepped into the studio. When she discovered that she stood on a heavily carpeted floor, there was an immediate protest. 'I cannot sing if I stand on a soft carpet. It is absolutely impossible. My voice is not the same.' (Of course the carpet was necessary to the successful broadcasting of the program but we've had previous experiences.) 'Certainly madam, you win. It is only the less experienced artists than yourself who do not realize that they cannot sing as well from a softly carpeted floor. Just one moment, this shall be remedied.'

"Recently, a new announcer handled his first program. His mother had listened-in but had failed to recognize the voice of her son—so carefully had he applied the art of correct tone and enunciation for the microphone in acquiring a 'radio voice.'

"On the other hand, not many days previous, another new announcer had been heard by a friend whom he had neither seen nor been in communication with for several years, but who, nevertheless, had not questioned for a moment the identity of the announcing voice, and telephoned a message of congratulation.

"One other little incident was a telegram from the station in Kansas City that was broadcasting President Coolidge's message to Congress by a direct wire from the Capitol. They claimed that they could hear President Coolidge turning the pages of his manuscript. An immediate check was made through the observing operator who sat in the gallery of the House. And strangely enough, the Kansas City station had actually heard the rustle of the manuscript over 3,600 miles of telephone line used in the event."

Margaret Madigan, well known young soprano who has broadcast from WJZ several times

Chicago Enters Northern Solitude

ON the stroke of twelve every Wednesday night a program is broadcast from WJAZ for a little band of men who sit huddled together in the forepart of the schooner *Bowdoin*, "frozen in," 11 degrees from the North Pole. Dr. Donald B. MacMillan and his exploration party are thus able to make a weekly visit back to the States—other than that, silence confronts them.

At a dinner given Dr. MacMillan, March 21st, 1923, he told of the true hardship of the Arctic—not the cold, not the lack of food, but the awful silence, so terrible indeed that men go mad because of it. He recalled one expedition in particular when this tragic fate befell a number of the party and the only way the remainder of the crew could get back to safety was to shoot them.

One of the guests at the dinner suggested that radio equipment should be taken on the next expedition. Two months later Dr. MacMillan arranged to take with him a dependable outfit.

So there they are—Dr. MacMillan and his crew of seven within a few miles of the North Pole, the deck of the boat covered with snow, to shut out the cold and keep within the little heat it is possible to generate. Stretched between the high masts of the *Bowdoin* is the antenna wire.

In Chicago, promptly at midnight, the announcer of WJAZ changes the call letters to 9XN and calls WNP (Wireless North Pole). Then he reads to them letters and messages from friends and relatives of weddings, births, and deaths; messages of all sorts from home.

When the personal messages have gone their way, a résumé of the week's news is given.

And such is the blessing of radio to the ice-bound adventurers, a little group of men all but crushed by the Northern silence.

A novel feature of WJAZ is the Crystal Studio. It is glass encased and sound proof. Although visitors to the station are separated from the studio by a triple plate-glass wall, they are enabled to hear the program by means of a receiving set located just outside.

Singer Meant Well But He Wore a Belt

MR. POPENOE, the winsome manager of WJY, complained that B. C. L.'s don't seem to realize that some mighty good stuff goes off the wire from that station.

Taking advantage of his permission to browse around behind the scenes we discovered that some "good stuff" does go off the wire—and a lot more that doesn't.

The Brooklyn Mark Strand Theater broadcasts a program every week that includes everything from grand opera to jazz. After a performance in the theater, the whole show, in costumes and war paint, jumps into taxis, rushes over to WJY, stages a radio "blow-out," and rushes back to the theater for another performance on the stage.

Getting the instruments into the studio, up and down the elevators, and arranging the cast entails a steady stream of people circulating through the station for well over an hour.

One night, the harps had been tuned and placed in position around the microphone ready to go on the air. Just at the moment when the operator "threw" the switch and signaled the players to start, one of the studio personnel stepped into the room, sniffed the air and immediately proceeded to open the windows! The result? Harps out of tune!

After the players had recovered, the culprit explained that he had merely wished to freshen the air in the room. He didn't know that an even temperature is absolutely essential to keep a harp in tune.

The Grand Opera tenor was scheduled next. His voice was so powerful he had to stand eight feet back from the microphone to insure perfect transmission. But he became so engrossed in the aria that he moved, step by step, toward the instrument, wringing his hands. The announcer moved the microphone, bit by bit, away from him until the wall had been reached. The singer's concentration defeated all attempts to catch his attention. There was but one recourse. He was unceremoniously jerked back by the simple expedient of grasping his belt. Incidently, he doesn't wear the belt any more—in the studio.

And by way of capping the climax, Mark Strand, the owner, can't listen-in on his own show because he lives in a suburb of New York that happens to be a "dead" area for receiving the stations located in New York.

Agnes Lenard, the only bedtime story-teller who sings the kiddies to sleep to the accompaniment of a ukelele, is a favorite with WJZ's younger audience

A new announcer recently introduced a speaker but forgot to "throw" the switch. The speaker talked to himself for several minutes before it was discovered that he wasn't on the air.

And speaking of announcers, T. H. Cowan received a letter from an unknown feminine admirer.

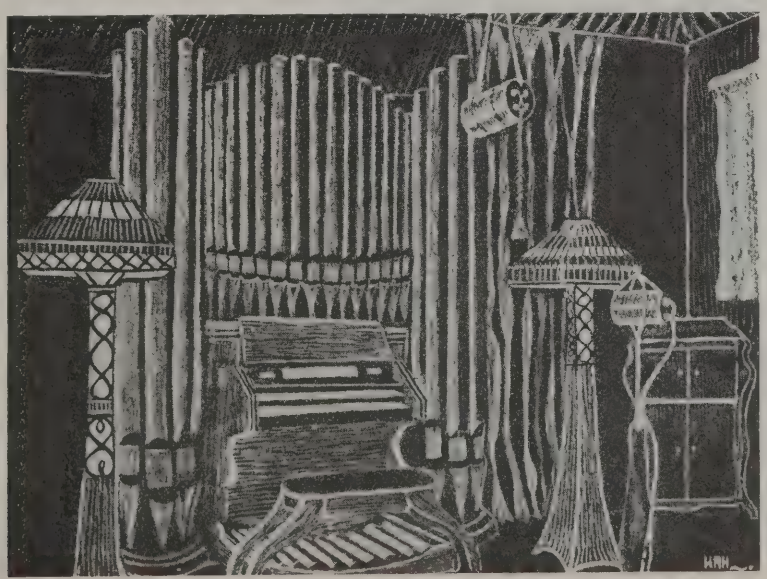
"I want to say a word for the announcer," the letter read. "I doubt if they realize how much they contribute to the enjoyment and thrill we women get from radio.

"He should have his picture printed along with the program for he is as well liked as a movie star, especially if he is young and his voice magnetic, as every woman thrills to the way a man says 'love,' 'lover,' 'sweetheart,' 'adore' and 'longing' and a hundred other words used in connection with the love between man and woman.

"There is something about a man's voice that sets our heart strings singing, especially if he is young and virile."

In answer to this prayer a picture of Cowan, in a striking pose, has been printed for the general edification of our readers, and the correspondent in particular.

Another letter to Mr. Cowan has irrevocably established his position with the women B. C. L.'s. That one, however, remains a state secret—at least a station secret.



The "Casovant" Pipe Organ, at station CKAC, Canada, was designed and built for radio broadcasting

Microphones Don't Tell What Announcers Don't Know

A NEW wrinkle in radio broadcasting was the masked singer at WTAM recently.

The mysterious unknown was several years ago a prominent figure in vaudeville. As a comedian and singer, he had reached the top of the profession, but seeing no future in store, he retired to an obscure but successful business career in Cleveland. However, he has been besieged with requests to "do his stuff" on several occasions but has always declined. Hence his insistence that his identity remain hidden when he consented to broadcast. His former partner in vaudeville was his accompanist and likewise had to remain incog. Manifestly, we are unable to publish their pictures.

Radio Movies Shown

THE near future will see the perfection of radio movies; essentially, they are here today. Anyone, with the aid of special apparatus, contained in a box about a foot square, and a small curtain, will be able to see as well as hear over the radio, according to C. Francis Jenkins of Washington, D. C.

The making of speaking films in Berlin. Experiments utilizing the radiophone to produce the "talking movies" are being made in Germany

Professor Jenkins, who has previously demonstrated the transmission of still pictures by radio, recently showed on a screen in his laboratory the movements of his hand and other objects held in front of his radio transmitting apparatus in another room. The apparatus used in transmitting still pictures was employed in the last experiment, but a new "lens-faced prismatic ring" was introduced to show a rapid succession of pictures depicting movement.

Perfection of the moving picture radio transmitting set now awaits only the manufacture of a new and more powerful electric lamp of the "corona-glow" type. In the recent demonstration, use was made of a temporary lamp by the inventor, but it is not strong enough to transmit large pictures. The question of rapidity is solved, Jenkins says, as he has already sent pictures at twice the standard movie speed. What he needs is a better and stronger lamp which will stand up when the signal strength is increased about 3,000 times, as is necessary in sending pictures in motion.

Not only actual pictures of moving bodies can be transmitted, by pointing the machine at them, but films can be broadcasted, Jenkins claims, and shown on screens in theaters or homes where proper receiving and reproducing apparatus and a screen are available. When the power of the light is raised the size of the picture can be increased, it was explained.

Broadcasting Boon to Wall Flowers

WOR has had requests to broadcast information concerning lost dogs, cats and other members of the family.

One day a wire came in from an elderly lady saying that she has been deaf for 40 years but at the moment of sending the telegram she was hearing for the first time. And it's our conservative guess that McCosker's "dope" on the "Hollywood" news was largely responsible.

A letter with a real human appeal was received from the matron of a Home for the Blind. Prayers of 700 blind persons were offered for the success of Mr. McCosker because he forms the connecting link between them and the current motion pictures.

One of the women listeners-in wrote to WOR that having been a charter member of the Wall Flowers Association, Local 23, she now had the station to thank for the loss of her card. It seems her husband had never previously been willing to learn the terpsichorean art but had finally taken up dancing lessons through the broadcast instructions of Arthur Murray.

T. H. Cowan, erstwhile known as "A.C.N.," the announcer with the magnetic voice

And inasmuch as a well known dancing teacher once said that husband and wife could never dance together because she was generally given to candid criticism, this would appear to mark another epoch in our great social evolution. The privacy of the home hath many blessings.

Dick Barthelmess recently broadcast a talk from WOR that retrieved an old college roommate who had always been "going to write" but had always been too busy. The urge to speak to him personally came from hearing his voice by radio.

Digging Coal to Prison Tempo

WOS, the one distinctly "farmers' radiophone" is located in the dome of the State Capitol at Jefferson City, Missouri.

Broadcasting market news on farm products and live stock is the primary service rendered by this station. Through it farmers in the middle west situated miles from any source of communication with the world are provided with information of live stock, grain and other market transactions before it is scarcely an hour old.

The broadcasting of musical programs from WOS on Monday, Wednesday and Friday nights has been proven to be no mere side line of service. Little did Missouri state officials think a year ago that the leader of the State Prison Band made up of thirty-two regulars would select from that number twenty expert musicians who would build up a national reputation for Missouri. The first anniversary of the Missouri State Prison Band broadcast an especially delightful program.

So thoroughly satisfied were the "listeners-in" that two hundred and eighteen of them sent prepaid telegrams to WOS expressing appreciation. Thirty-seven states and three provinces of Canada were represented in the flood of congratulatory telegrams to WOS and the Missouri Prison Band boys. The detailed list of telegrams by states proves conclusively that WOS with its State Prison musical experts has attained remarkable success and popularity throughout the United States.

Two men deep beneath the surface of the earth in their quarters in an Illinois coal mine reported enjoying the wonderful "music of the air." A crew of trainmen in North Dakota wired that they were enjoying the Prison Band program from a Northern Pacific caboose. Frequently, ranchers in isolated sections of the far west wire or

write appreciation of the Band Concerts. Ships at sea are now and then among those reporting.

Pathos, wit, humor and irony are unstintingly used by WOS correspondents in expressing themselves regarding the broadcasting. Thus, the decidedly human side of the hundreds of thousands of American radio fans is revealed. Frequent communications express sorrow that talented artists such as compose the Missouri State Prison Band must linger behind the high, gray stone walls at "Silent City." One man wrote that if he were Governor of Missouri he would pardon the whole bunch of the band boys.

Others write: "Hold them there for life, so we radio bugs can enjoy their fine music." Still others opine that all of the "musically confined" experts in the United States must be segregated behind the big prison walls in Jefferson City, Missouri. Quite a number have inquired whether the cornet soloist could be parolled to them. Others express a preference for the talented pianist. Some want the jazzy saxophonist. Running like a golden thread throughout the entire correspondence, however, is a philosophical note which proves that the hundreds of thousands of "listeners-in" are, after all, true-type Americans interested in improving social conditions that make prisons necessary.

The thousands of letters and telegrams received from all over North America even to far away Alaska, from ships on the Atlantic, the Caribbean, and the Gulf, and from Old Mexico, Cuba, Porto Rico, Hawaii, Newfoundland, and other distant points, go far toward lifting the heavy burden from the lives of the unfortunate boys behind the big stone walls. The many letters, postals and telegrams provide hours of interesting reading and pastime for them. The tobacco supplies so liberally sent to WOS for the consumption of the Prison Band Boys is also greatly appreciated by them.

Although the State Prison Band is a frequent performer at WOS, it by no means has a monopoly on broadcasting successful and popular programs. The management of WOS has invited all of the approximately forty institutions of higher learning in Missouri to broadcast musical and educational programs. The group of twenty Junior Colleges for Girls have responded most splendidly; a number of them have broadcast delightful programs from WOS. College professors from the State University regularly broadcast lectures.

The Old-Time Missouri Fiddlers broadcast from WOS their first anniversary program. No one realized that this was such a feet-shaking nation until the congratulatory telegrams began pouring in. The operators found it necessary to notify their audience that it was too disturbing to sit at the telephone to answer the continuous string of long distance calls that were still awaiting on the line after the 17th one had been answered. These old fellows played Turkey in the Straw, Arkansas Traveler, Pop Goes the Weasel, Leather Breeches, Wild Boy, and other old time country rag selections.

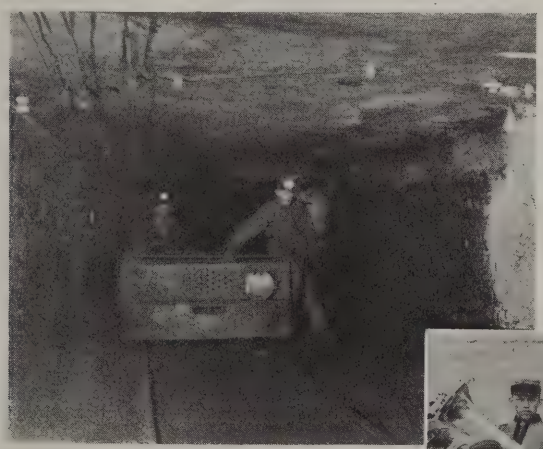
Mme. Glukeya Campanieskaja, "Russia's Great Carmen," who has but recently arrived in this country, broadcasting from WJZ

Then follows a statement in French, afterward repeated in English, as to the selections and artists. The numbers of the program alternate for the French and English listeners-in, the announcements being made in both languages.

The novelty of this bilingual arrangement appeals to Uncle Sam's audience. The mail pouch daily has a large collection of letters from all over the continent.

The common illusion that Parisians cannot understand the dialect of the French in Quebec has been exploded by acknowledgments of enjoyed reception from gay Paree. A ship operator reported excellent reception in the Bay of Biscay.

A noteworthy feature of this station is the pipe organ that is part of the equipment, especially and compactly built for radio transmission. A brief recital on this Casovant forms part of nearly all of CKAC's concerts.

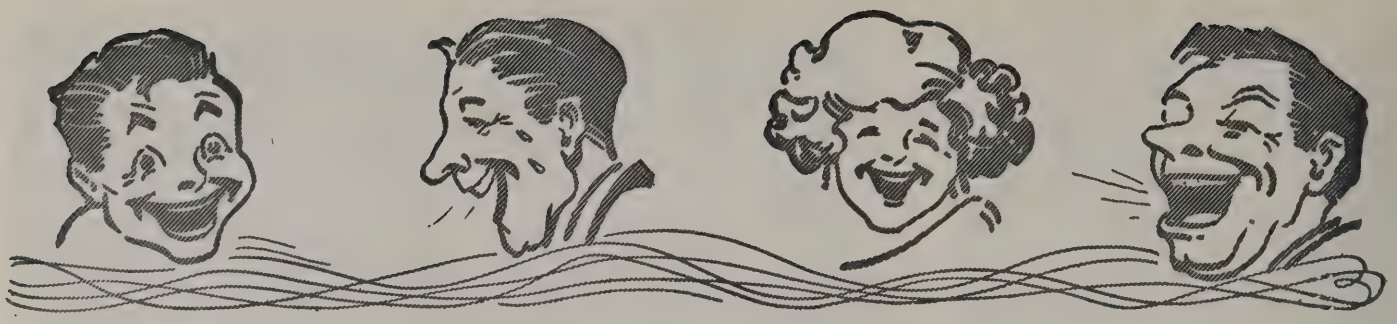


The Prison Band at WOS and a scene in the mine where the band music was heard by radio. Both represent new innovations in the broadcast and B.C.L. field of radio transmission and reception.

Bilingualism and Accents

J. N. CARTIER, manager and announcer at the Canadian station CKAC, begins each broadcast:

POSTE Say-Kah-Ah-Say,
La Presse, Montreal.



Laughter on the Radio Wave

Technical Giggles

By Jack Bront

We fully anticipated the fact that broadcasting would ultimately pass "into the hands of receivers."

We have failed so far to communicate with the spirits through radio. We suggest the use of phantom antennas on a dark night.

We're glad we're not a radio operator over in Holland. Try this on your microphone, after first calling in the fire department: "Tankstoombootmaatschappij;" or this little German zephyr: "Dampschiffahrtsgesellschaft."

What more could you wish than a "two-step" for radio dancing?

Willie maintains the wire on his single circuit coil is hard drawn. It took six days to extract six simoleons from Pa.

Prohibition has even affected the radio business. View the dry cell tube. Who uses a wet battery now?

The lad nowadays burns the midnight filament in preference to the midnight oil of yore.

High inductances at the broadcasting station should result in many "good turns" to listeners.

In radio at least, we know "distance" makes the heart grow fonder.

Instructive broadcasting from aircraft can be well deemed "education on a higher plane."

Japanese fishing fleets employing radio will be angling both above and below. The habit should be nothing less than catching.

Glendora inquires if the naval airship going to the pole will communicate with the south by means of polarized relays. We assume it will take some cold calculation to accomplish the result.

Glendora naively suggests that in her musical broadcasts, kind Nature supplies the "air." At least the broadcast station manager has not, so far, given her the "air."

We cannot help but admire the manner in which broadcasting does the formerly impossible. "Samples" of opera are distributed to the ticket buying public at first hand, just as if they were containers of nose powder or yard goods.

The Gift Shoppe station will broadcast as a first number the popular refrain: "Yes, We Have No Bandannas."

H. V. Neff, a student in the Evergreen School for the Blind, at Baltimore, Md., apologized to WGY for not earlier acknowledging the pleasure he received from the program of the Schenectady station. "Bum spelling was the cause of my not writing sooner," he wrote. "I just learned this morning how to spell the city in which you are located and I don't know now whether or not I am right."

A Schenectady woman, wife of a school teacher, asked WGY to broadcast a request for a flat. She described and specified the number of rooms she desired and the rent it was possible for her to pay and also mentioned the streets she preferred.

Mr. Mason, who is retired, informed WGY that he was camping in the wilds north of Grand Rapids, Mich., and the only interruption to the perfect transmission of WGY was the noise of a bear.

WGY, the General Electric Company broadcasting station at Schenectady, N. Y., indirectly controls the turning on and off of the street lights at Howard Beach, about 25 miles from New York. William L. Welling of that place reports that he depends on WGY for the correct time to switch off the street light in Howard Beach.

MR. BOZO 'LL START HIS HORRID RADIO AGAIN TO-NIGHT AS SOON AS HE GETS HOME — UNLESS — YOU GO UP ON THE ROOF AND CUT HIS AERIAL!
AH!
BOZO'S GOING TO BE OUTA LUCK!
SNIP!
LISTEN!!--!!
DIDN'T YOU DO WHAT I TOLD YOU?
SQUAWK
ROAR
SQUEAL
HOT DOG! I'VE JUST IMPROVED MY RADIO 100% - I'VE RIGGED UP THIS INDOOR LOOP - I'M DISCONTINUING MY AERIAL ON THE ROOF - NOW YOU CAN HEAR IT 12 BLOCKS AWAY!!!
THIS LITTLE IDEA OF TWO FAMILIES SHARING ONE FLAT IS NOT PROVING A BED OF ROSES, BUT LETS NOT GET DISCOURAGED

N. Y. Evening World

COME ON! DOLL UP DEAR! THE BOSS TOOK ME BACK, AND TO CELEBRATE, I'VE BOUGHT TICKETS FOR A SHOW!!!
WELL! SPEED UP A BIT, MOVE!!
NOW, WHAT'S THE BIG IDEA? WHY THE RADIO—
SO'S WE CAN HEAR WHAT THE ACTORS ARE SAYING FROM THESE SEATS! COME ON!
APPLESAUCE
THE REAL STUFF BOSS JUST OFF THE BOAT

N. Y. Evening World

BROADCASTING STATION DIRECTORY

(Revised to January 15th, 1923)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer.....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLN	Monterey Electric Shop.....Monterey, Calif.	261
KLS	Warner Brothers.....Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	286
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros.....San Francisco, Calif.	423
KQI	University of California.....Berkeley, Calif.	360
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreid.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
KSD	Post-Dispatch.....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co., San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop.....Honolulu, T. H.	360
KWY	Westinghouse Elec. & Mfg. Co....Chicago, Ill.	536
KZM	Preston, D. Allen.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDLY	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre.....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology...Portland, Ore.	360
KDYS	The Tribune, Inc.....Great Falls, Mont.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co...Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company.....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co.....Reno, Nev.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZT	Seattle Radio Association.....Seattle, Wash.	360
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	360
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	Electric Shop.....Moscow, Idaho	360
KFAP	Standard Publishing Co.....Butte, Mont.	360
KFAR	Studio Lighting Service Co.....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAY	W. J. Virgin.....Medford, Ore.	283
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFBB	F. A. Buttrey & Co.....Havre Mont.	360
KFBC	W. K. Azbill.....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros.....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....LeMars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDB	Mercantile Trust Co.....San Francisco, Calif.	509
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Corvallis, Ore.	360
KFDJ	Oregon Agri. College.....Denver, Colo.	360
KFDL	Knight-Campbell Music Co.....Bozeman, Mont.	248
KFDO	H. E. Cutting.....	
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbreth & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEP	Radio Equipment Co.....Oak, Nebr.	240
KFEQ	J. L. Scroggin.....Douglas, Wyo.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Minneapolis, Minn.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs., St. Louis, Mo.	360
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Markschoffel Motor Co....Colorado Springs, Colo.	360
KFFR	Jim Kirk .....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co.....Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Co., 138th Inf., St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Co., Berrien Spgs., Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	The Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHJ	Fallon Co. .....Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store, Los Gatos, Calif.	242
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip Laskowitz .....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ, Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories .....Seattle, Wash.	236
KFIZ	Daily Commonwealth .....Fond du Lac, Wisc.	273
KFJB	Marshall Electric Co., Inc...Marshalltown, Iowa	248
KFJC	Post Intelligencer .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co...Oklahoma City, Okla.	252
KFJH	The Sugar Bowl.....Selma, Calif.	273
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJJ	Carrollton Radio Shop.....Carrollton, Mo.	236
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJR	Ashley C. Dixon & Co.....Stevensville, Mont.	258
KFJV	T. H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College...Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College...Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Electric Co.....Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co...Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Educational Service.....Denver, Colo.	268
KFLH	Erickson Radio Co., Inc....Salt Lake City, Utah	261
KFLP	Everett M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. M.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	Rev. A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co....Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Texas	240
KFLY	Fargo Radio Supply Co.....Fargo, N. D.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College.....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KFMT	Dr. George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Brothers .....San Marcos, Texas	240
WBL	T. & H. Radio Co.....Anthony, Kans.	261
WSB	May & Co.....Newark, N. J.	360
WBR	Pennsylvania State Police.....Butler, Pa.	286
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co..Springfield, Mass.	337
WCK	Stix-Baer-Fuller .....St. Louis Mo.	360
WCM	University of Texas.....Austin, Texas	517
WCX	Detroit Free Press.....Detroit, Mich.	360
WDM	Church of the Covenant.....Washington, D. C.	
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation, New York, N. Y.	405
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co. .....St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	360
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre....New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cinco Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co.....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp. of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America—Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKY	Oklahoma Radio Shop....Oklahoma City, Okla.	360
WLB	University of Minnesota.....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co.....Indianapolis, Ind.	360
WLW	Crosley Manufacturing Co.....Cincinnati, Ohio	309
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMH	Precision Equipment Co.....Cincinnati, Ohio	248
WMU	Doubleday-Hill Elec. Co.....Pittsburgh, Pa.	261
WNJ	Shotten Radio Mfg. Co.....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic..Davenport, Iowa	484
WOI	Iowa State College:.....Ames, Iowa	360
WOK	Arkansas Light & Power Co...Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co.....Kansas City, Mo.	360
WOR	L. Bamberger Co.....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record.....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm.....New Lebanon, Ohio	234
WPI	Electric Supply Co.....Clearfield, Pa.	360
WQX	Walter A. Kushl.....Chicago, Ill.	360
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co.....Hamilton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co.....Utica, N. Y.	273
WSY	Alabama Power Co.....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co. .....Toledo, Ohio	360
WTG	Kansas State Agri. College....Manhattan, Kans.	360
WTP	George M. McBride.....Bay City, Mich.	360
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	The Detroit News.....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal.....Chicago, Ill.	286
WAAM	L. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	264
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co.....Decatur, Ga.	360
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.....Emporia, Kans.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence.....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.....Anderson, Ind.	229
WABD	Parker High School.....Dayton, Ohio	286
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co....Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College.....Storrs, Conn.	283
WABM	F. E. Doherty.....Saginaw, Mich.	254
WABN	Waldo C. Grover.....La Crosse, Wisc.	234
WABO	Lake Avenue Baptist Church....Rochester, N. Y.	252
WABP	Robert F. Weinhig .....Dover, Ohio	266
WABQ	Haverford College Radio Club...Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt, Jr.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WAJV	Indian Pipe Line Corp.....Princeton, Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	246
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	224
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufman & Baer Co.....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel.....Houston, Tex.	360
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360

WCAP Chesapeake & Potomac Tel. Co., Washington, D. C. 469
WCAR Alamo Radio Electric Co.....San Antonio, Tex. 360
WCAS Dunworthy Industrial Institute, Minneapolis, Minn. 246
WCAT South Dakota School of Mines..Rapid City, S. D. 240
WCAU Durham & Co.....Philadelphia, Pa. 286
WCAV J. C. Dice Electric Co.....Little Rock, Ark. 360
WCAX University of Vermont.....Burlington, Vt. 360
WCAY Kesselman O'Driscoll Music House, Milwaukee, Wisc. 261
WCAZ Carthage College .....Carthage, Ill. 246
WCBA Charles W. Haimbach.....Allentown Pa. 280
WCBD Zion Radio Broadcasting Station.....Zion, Ill. 345
WDAE Tampa Daily Times.....Tampa, Fla. 360
WDAF Kansas City Star.....Kansas City, Mo. 411
WDAG Martin J. Laurence.....Amarillo, Tex. 263
WDAH Trinity Methodist Church.....El Paso, Texas 268
WDAK Hartford Courant .....Hartford, Conn. 261
WDAL Florida Times Union.....Jacksonville, Fla. 360
WDAM Weston Electric Co.....New York, N. Y. 360
WDAO Automotive Electric Co.....Dallas, Tex. 360
WDAP The Board of Trade.....Chicago, Ill. 360
WDAR Lit Brothers .....Philadelphia, Pa. 395
WDAS Samuel W. Walte.....Worcester, Mass. 360
WDAU Slocum & Kilburn.....New Bedford, Mass. 360
WDAX First National Bank.....Centerville, Iowa 268
WDAY Fargo Radio Service Co.....Fargo, N. D. 244
WDBC Kirk Johnson & Co., Inc.....Lancaster, Pa. 258
WEAA Fallain & Lathrop.....Flint, Mich. 280
WEAE Virginia Polytechnic Institute...Blacksburg, Va. 360
WEAF American Tel. & Tel.....New York, N. Y. 492
WEAH Wichita Board of Trade.....Wichita, Kans. 244
WEAI Cornell University .....Ithaca, N. Y. 286
WEAJ University of South Dakota....Vermillion, S. D. 283
WEAM North Plainfield, Borough of Plainfield, North Plainfield, N. J. 252
WEAN Shepard Co. .....Providence, R. I. 273
WEAO Ohio State University.....Columbus, Ohio 360
WEAP Mobile Radio Co., Inc.....Mobile, Ala. 360
WEAR Baltimore Am. & News Pub. Co., Baltimore, Md. 360
WEAS Hecht Company .....Washington, D. C. 360
WEAU Davidson Brothers Co.....Sioux City, Iowa 360
WEAY Will Horwitz, Jr.....Houston, Tex. 360
WEAZ Donald Redmond .....Waterloo, Iowa 360
WFAA A. H. Belo & Co.....Dallas, Tex. 476
WFAB Carl C. Woese.....Syracuse, N. Y. 234
WFAF Henry C. Spratley.....Poughkeepsie, N. Y. 273
WFAG Radio Engineering Laboratory, Waterford, N. Y. 360
WFAH Electric Supply Co.....Port Arthur, Tex. 236
WFAJ Hi-Grade Wireless Instrument Co., Asheville, N. C. 360
WFAM Times Publishing Co.....St. Cloud, Minn. 360
WFAN Hutchinson Elec. Service Co..Hutchinson, Minn. 360
WFAQ Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo. 360
WFAT New Columbus College.....Sioux Falls, S. D. 258
WFAV University of Nebraska.....Lincoln, Nebr. 275
WGAC Orpheum Radio Stores Co.....Brooklyn, N. Y. 360
WGAD Spanish Am. Sch. of Telegraphy, Enconada, P. R. 360
WGAJ W. H. Glass.....Shenandoah, Iowa 360
WGAL Lancaster Elec. Supply & Const. Co., Lancaster, Pa. 248
WGAN Cecil E. Lloyd.....Pensacola, Fla. 360
WGAQ W. G. Patterson.....Shreveport, La. 360
WGAW Ernest C. Albright.....Altoona, Pa. 261
WGAX Radio Electric Co., Washington Courthouse, Ohio 360
WGAY North Western Radio Co.....Madison, Wisc. 360
WGAZ South Bend Tribune.....South Bend, Ind. 360
WHAA State University of Iowa.....Iowa City, Iowa 283
WHAB Clark W. Thompson.....Galveston, Tex. 360
WHAD Marquette University .....Milwaukee, Wisc. 360
WHAG University of Cincinnati.....Cincinnati, Ohio 222
WHAH Hafner Supply Co.....Joplin, Mo. 283
WHAK Roberts Hardware Co.....Clarksburg, West Va. 258
WHAM Eastman School of Music of Univ. of Rochester, Rochester, N. Y. 283
WHAP Dewey L. Otta.....Decatur, Ill. 360
WHAR Paramount Radio and Elec. Co., Atlantic City, N. J. 231
WHAS Courier Journal & Times.....Louisville, Ky. 400
WHAV Wilmington Elec. & Supply Co., Wilmington, Del. 360
WHAX Huntington Press .....Huntington, Ind. 360
WHAZ Rensselaer Polytechnic Institute....Troy, N. Y. 380
WIAB Joslyn Automobile Co.....Rochford, Ill. 360
WIAD Howard R. Miller.....Philadelphia, Pa. 254
WIAF Gustav A. De Cortin.....New Orleans, La. 234
WIAH Continental Radio and Mfg. Co., Inc., Newton, Iowa 258
WIAI Heers Stores Co.....Springfield, Mo. 252

WIAK Journal Stockman Co.....Omaha, Nebr. 278
WIAP J. R. Rudy & Sons.....Paducah, Ky. 360
WIAQ Chronicle Publishing Co.....Marion, Ind. 226
WIAS Burlington Hawkeye-Home Elec. Co., Burlington, Ia. 360
WIAU American Sec. & Sav. Bank.....Le Mars, Ia. 360
WIAV New York Radio Laboratories, Binghamton, N. Y. 360
WIAW Saginaw Radio & Elec. Co.....Saginaw, Mich. 360
WJAD Jackson's Radio Eng. Lab.....Waco, Tex. 360
WJAF Press Pub. Co.....Muncie, Ind. 360
WJAG Norfolk Daily News.....Norfolk, Nebr. 283
WJAJ Y. M. C. A.....Dayton, Ohio 360
WJAK Rev. C. L. White.....Greentown, Ind. 254
WJAM D. C. Perham.....Cedar Rapids, Iowa 268
WJAN Peoria Star Co.....Peoria, Ill. 280
WJAR The Outlet Co.....Providence, R. I. 360
WJAS Capper Publications.....Pittsburgh, Pa. 360
WJAT Kelly-Vawter Jewelry Co.....Marshall, Mo. 360
WJAX Union Trust Co.....Cleveland, Ohio 390
WJAZ Chicago Radio Laboratory.....Chicago, Ill. 448
WKAA H. F. Paar.....Cedar Rapids, Iowa 268
WKAD Charles Looff.....East Providence, R. I. 240
WKAF W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex. 360
WKAN Alabama Radio Mfg. Co.....Montgomery, Ala. 360
WKAP Dutee Wilcox Flint.....,Cranston, R. I. 360
WKAQ Radio Corporation of Porto Rico, San Juan, P. R. 360
WKAR Michigan Agri. College....East Lansing, Mich. 280
WKAS L. E. Lines Music Co.....Springfield, Mo. 360
WKAV Laconia Radio Club.....Laconia, N. H. 254
WKAW United Battery Service Co., Montgomery, Ala. 225
WKAY Brenau College .....Gainesville, Ga. 280
WLAG Cutting & Washington Radio Corp., Minneapolis, Minn. 417
WLAH Samuel Woodworth .....Syracuse, N. Y. 234
WLAJ Waco Electrical Supply Co.....Waco, Tex. 360
WLAK Vermont Farm Mach. Co.....Bellows Falls, Vt. 360
WLAL Tulsa Radio Co.....Tulsa, Okla. 360
WLAN Putnam Hardware Co.....Houlton, Me. 283
WLAP W. V. Jordon.....Louisville, Ky. 360
WLAQ Arthur S. Schilling.....Kalamazoo, Mich. 283
WOAR Henry P. Lundskow.....Kenosha, Wis. 229
WLAS Central Radio Supply Co.....Hutchinson, Kans. 244
WLAT Radio and Specialty Co.....Burlington, Iowa 360
WLAV Electric Shop, Inc.....Pensacola, Fla. 254
WLAW New York Police Dept.....New York, N. Y. 360
WLAX Greencastle Community Broadcasting Station, Greencastle, Ind. 231
WMAB Radio Supply Co.....Oklahoma City, Okla. 360
WMAC J. Edward Page.....Cazenovia, N. Y. 261
WMAF Round Hills Radio Corp.....Dartmouth, Mass. 360
WMAH General Supply Co.....Lincoln, Nebr. 254
WMAJ Drovers Telegram Co.....Kansas City, Mo. 275
WMAK Norton Laboratories.....Lockport, N. Y. 360
WMAL Trenton Hdw. Co.....Trenton, N. J. 250
WMAN First Baptist Church.....Columbus, Ohio 286
WMAP Utility Battery Service, Inc.....Easton, Ohio 246
WMAQ Chicago Daily News.....Chicago, Ill. 448
WMAV Alabama Polytechnic Institute.....Auburn, Ala. 250
WMAW Wahpeton Elec. Co.....Wahpeton, N. D. 360
WMAY Kingshighway Presby. Church....St. Louis, Mo. 280
WMAZ Mercer University .....Macon, Ga. 268
WNAC Shepard Stores .....Boston, Mass. 278
WNAD Oklahoma Radio Eng. Co.....Norman, Okla. 360
WNAL R. J. Rockwell.....Omaha, Nebr. 242
WNAM Ideal Apparatus Co.....Evansville, Ind. 360
WNAN Syracuse Radio Telephone Co..Syracuse, N. Y. 286
WNAP Wittenberg College .....Springfield, Ohio 360
WNAQ Charleston Radio Elec. Co.....Charleston, S. C. 360
WNAR Rhodes, C. C. .....Butler, Mo. 231
WNAS Texas Radio Corporation and Austin Statesman, Austin, Tex. 360
WNAT Lenning Bros. Co.....Philadelphia, Pa. 360
WNAV Peoples Tel. & Tel. Co.....Knoxville, Tenn. 236
WNAW Henry Kunzmann .....Fortress Monroe, Va. 360
WNAX Dakota Radio Apparatus Co.....Yankton, S. D. 244
WNAY Ship Owners' Radio Service.....Baltimore, Md. 360
WOAA Dr. Walter Hardy.....Ardmore, Okla. 360
WOAC Maus Radio Co.....Lima, Ohio 266
WOAD Friday Battery & Elec. Co.....Sigourney, Iowa 360
WOAE Midland College .....Fremont, Nebr. 360
WOAF Tyler Commercial College.....Tyler, Tex. 360
WOAG Apollo Theatre .....Belvidere, Ill. 224
WOAH Palmetto Radio Corp.....Charleston, S. C. 360
WOAI Southern Equipment Co.....San Antonio, Texas 385
WOAJ Ervin's Electrical Co.....Parsons, Kans. 360
WOAL Wm. Evans Woods.....Webster Groves, Mo. 286
WOAN James D. Vaughn.....Lawrenceburg, Tenn. 360
WOAP Kalamazoo College .....Kalamazoo, Mich. 360
WOAT Boyd Martell Hamp .....Wilmington, Del. 360
WOAV Pennsylvania National Guard.....Erie, Pa. 242
WOAW Woodmen of the World.....Omaha, Nebr. 526

WOAX Franklyn J. Wolff.....Trenton, N. J. 240
WPAB Pennsylvania State College..State College, Pa. 283
WPAC Donaldson Radio Co. .....Okmulgee, Okla. 360
WPAG Central Radio Co., Inc.....Independence, Mo. 360
WPAH Wisconsin Dept. of Markets.....Waupaca, Wisc. 360
WPAJ Doolittle Radio Corporation...New Haven, Conn. 268
WPAK No. Dakota Agricultural College...Fargo, N. D. 360
WPAL Superior Radio & Telephone Co., Columbus, Ohio 286
WPAM Awerbach & Guettel.....Topeka, Kans. 360
WPAP Theodore D. Phillips.....Winchester, Ky. 360
WPAQ General Sales & Eng. Co.....Frostburg, Md. 360
WPAS J. & M. Electric Co.....Amsterdam, N. Y. 360
WPAT St. Patrick's Cathedral.....El Paso, Tex. 360
WPAU Concordia College .....Moorhead, Minn. 360
WPAY Bangor Radio Laboratory.....Bangor, Me. 360
WPAZ John R. Koch.....Charleston, West Vo. 273
WQAA Horace A. Beale, Jr.....Parkersburg, W. Va. 360
WQAC E. B. Gish.....Amarillo, Tex. 360
WQAD Whitehall Electric Co.....Waterbury, Conn. 242
WQAE Moore Radio News Station.....Springfield, Vt. 275
WQAF Sandusky Register .....Sandusky, Ohio 240
WQAH Brock Anderson Elec. Eng. Co., Lexington, Ky. 254
WQAK Appel-Higley Electric Co.....Dubuque, Iowa 360
WQAL Cole County Tel. & Tel. Co.....Mattoon, Ill. 258
WQAM Electrical Equipment Co.....Miami, Fla. 360
WQAN Scranton Times .....Scranton, Pa. 360
WQAO Calvary Baptist Church.....New York, N. Y. 360
WQAQ West Texas Radio Co.....Abilene, Tex. 360
WQAS Prince Walter Co.....Lowell, Mass. 266
WQAT Radio Equipment Corporation.....Richmond, Va. 360
WQAV Huntington and Guerry, Inc....Greenville, S. C. 258
WQAW Catholic University of America, Washington, D. C. 236
WQAX Radio Equipment Co. .....Peoria, Ill. 360
WRAA Rice Institute .....Houston, Tex. 360
WRAD Taylor Radio Shop.....Marion, Kans. 248
WRAF Radio Club, Inc.....Laporte, Ind. 224
WRAH Stanley N. Reed.....Providence, R. I. 231
WRAL Northern States Power Co..St. Croix Falls, Wisc. 248
WRAM Lombard College .....Galesburg, Ill. 244
WRAN Black-Hawk Electric Co.....Waterloo, Iowa 236
WRAO Radio Service Co.....St. Louis, Mo. 360
WRAV Antioch College .....Yellow Springs, Ohio 360
WRAW Horace D. Good.....Reading, Pa. 238
WRAX Flexon's Garage .....Gloucester City, N. J. 268
WRAY Radio Sales Corporation.....Scranton, Pa. 280
WRAZ Rensselaer Polytechnic Institute....Troy, N. Y. 380
WSAA B. S. Sprague Elec. Co.....Marietta, Ohio 360
WSAB Southeast Mo. State College, Cape Girardeau, Mo. 360
WSAC Clemson Agri. College....Clemson College, S. C. 360
WSAD J. A. Foster Co.....Providence, R. I. 261
WSAH A. G. Leonard Jr.....Chicago, Ill. 248
WSAI U. S. Playing Card Co.....Cincinnati, Ohio 309
WSAJ Grove City College.....Grove City, Pa. 360
WSAL Franklin Electrical Co.....Brookville, Ind. 246
WSAN Allentown Radio Club.....Allentown, Pa. 229
WSAP Seventh Day Adventist Church..New York, N. Y. 263
WSAR Doughty & Welch Elec. Co.....Fall River, Mass. 254
WSAT Plainview Elec. Co.....Plainview, Tex. 268
WSAW Curtice & McElwee.....Canandaigua, N. Y. 275
WSAX Chicago Radio Laboratory.....Chicago, Ill. 268
WSAY Irving Austin, Chamber of Commerce, Port Chester, N. Y. 233
WSAZ Chase Electric Shop.....Pomeroy, Ohio 258
WTAB Fall River Daily Herald.....Fall River, Mass. 248
WTAC Penn Traffic Co. .....Johnstown, Pa. 360
WTAG Kern Music Co.....Providence, R. I. 258
WTAH Carmen Ferro .....Belvidere, Ill. 236
WTAJ The Radio Shop.....Portland, Me. 236
WTAL Toledo Radio and Electrical Co., Toledo, Ohio 252
WTAM Willard Storage Battery Co.....Cleveland, Ohio 390
WTAN Orndorff Radio Shop.....Mattoon, Ill. 240
WTAP Cambridge Radio & Electric Co..Cambridge, Ill. 390
WTAQ S. H. Van Gorden & Sons.....Osselo, Wisc. 226
WTAR Reliance Electric Co.....Norfolk, Va. 226
WTAS Charles E. Erbstein.....Elgin, Ill. 275
WTAT Edison Elect. Ill. Co.....Boston, Mass. 244
WTAU Ruegy Battery & Elec. Co.....Tecumseh, Nebr. 360
WTAW Agricultural and Mech. College, College Station, Tex. 254
WTAX Williams Hardware Co.....Streator, Ill. 231
WTAY Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill. 226
WTAZ Thomas J. McGuire.....Lambertville, N. J. 283
WWAB Swern Hoenig & Co.....Trenton, N. J. 226
WWAC Sanger Brothers .....Waco, Tex. 360
WWAD Wright & Wright, Inc.....Philadelphia, Pa. 360
WWAE Alamo Dance Hall.....Joliet, Ill. 227
WWAF Galvin Radio Supply Co.....Camden, N. J. 236
WWAH General Supply Co.....Lincoln, Nebr. 360
WWAO Michigan College of Mines....Houghton, Mich. 244

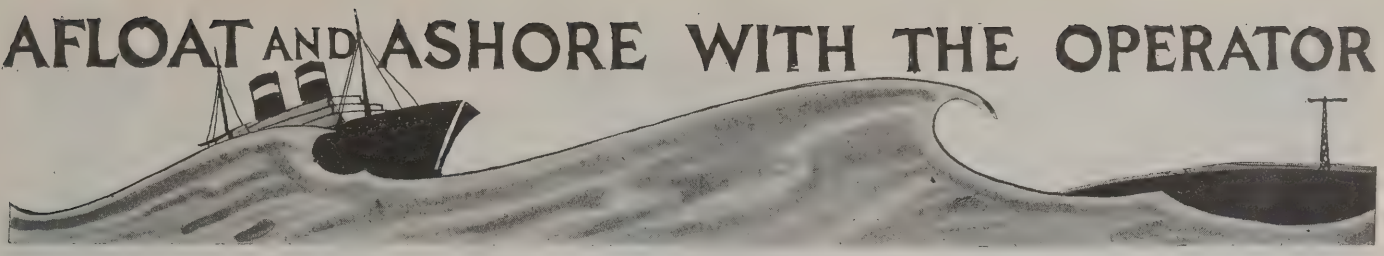
Canadian Broadcasting Stations

CKY Manitoba Telephone System.....Winnipeg, Manitoba
CFAC Radio Corporation of Calgary, Ltd...Calgary, Alberta
CFCA Star Publishing and Printing Co., Toronto, Ontario
CFCB Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.
CFCD Canadian Westinghouse Co., Ltd., Winnipeg, Manitoba
CFCE Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia
CFCF Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec
CFCH Abitibi Power and Paper Co., Ltd., Iroquois Falls, Ontario
CFCI Motor Products Corporation.....Walkerville, Ontario
CFCN W. W. Grant Radio, Ltd.....Calgary, Alberta
CFCX The London Advertiser.....London, Ontario
CFPC International Radio Development Co., Fort Frances, Ontario
CFTC The Bell Telephone Co. of Canada....Toronto, Ontario
CFUC University of Montreal.....Montreal, Quebec
CFVC Roy Russell Brown.....Courtenay, British Columbia
CFYC Victor Wentworth Odium.....Vancouver, B. C.
CFZC Canadian Westinghouse Co., Ltd....Montreal, Quebec
CHAC Radio Engineers, Ltd.....Halifax, Nova Scotia

CHBC The Albertan Publishing Co.....Calgary, Alberta
CHCA Radio Corporation of Vancouver, Ltd., Vancouver, B. C.
CHCB Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario
CHCC Canadian Westinghouse Co., Ltd., Edmonton, Alberta
CHCF Radio Corporation of Winnipeg Ltd., Winnipeg, Manitoba
CHCQ The Western Radio Co., Ltd.....Calgary, Alberta
CHCS London Radio Shoppe .....London, Ontario
CHCX B. L. Silver.....Montreal, Quebec
CHCZ The Globe Printing Co.....Toronto, Ontario
CHFC John Millen & Sons, Ltd.....Toronto, Ontario
CHIC Canadian Westinghouse Co., Ltd....Hamilton, Ontario
CHOC Canadian Westinghouse Co., Ltd....Vancouver, B. C.
CHVC Metropolitan Motors, Ltd.....Toronto, Ontario
CHXC J. R. Booth, Jr.....Ottawa, Quebec
CHYC Northern Electric Co.....Montreal, Quebec
CJBC Dupuis Frères .....Montreal, Quebec
CJCA The Edmonton Journal, Ltd.....Edmonton, Alberta
CJCB James Gordon Bennett.....Nelson, British Columbia
CJCD T. Eaton Co., Ltd.....Toronto, Ontario
CJCE Vancouver Sun Radiotelephones, Ltd., Vancouver, B. C.
CJCF News Record, Ltd.....Kitchener, Ontario
CJCG Manitoba Free Press Co., Ltd....Winnipeg, Manitoba

CJCH The United Farmers of Ontario.....Toronto, Ontario
CJCI McLean, Holt & Co., Ltd....St. John, New Brunswick
CJCN Simons Agnew & Co.....Toronto, Ontario
CJCS Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia
CJCY Edmund Taylor .....Calgary, Alberta
CJGC London Free Press Printing Co., Ltd., London, Ontario
CJNC Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba
CJSC The Evening Telegram .....Toronto, Ontario
CKAC La Presse Publishing Co.....Montreal, Quebec
CKCB T. Eaton Co., Ltd.....Winnipeg, Manitoba
CKCD Vancouver Daily Province.....Vancouver, B. C.
CKCE Canadian Independent Telephone Co., Ltd., Toronto, Ontario
CKCK Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan
CKCR Jones Electric Radio Co.....St. John, New Brunswick
CKCS The Bell Telephone Co. of Canada...Montreal, Quebec
CKCZ Canadian Westinghouse Co., Ltd.....Toronto, Ontario
CKKC Radio Equipment and Supply Co.....Toronto, Ontario
CKOC The Wentworth Radio Supply Co....Hamilton, Ontario
CKQC Radio Supply Co. of London.....London, Ontario
CKZC Salton Radio Engineering Co.....Winnipeg, Manitoba

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

THERE are few radio men who could not find cause to be envious of the excellent record, accomplishments and ability of Steffen F. Nielssen, operator on W. K. Vanderbilt's yacht *Ara*.

Nielssen is the highest salaried marine radio operator in the world, and is in charge of a station on the *Ara* that is equal in cost and effectiveness to any afloat, with the exception of two or three of the largest liners carrying three or more operators. Regardless of at what point the yacht is located on her extended cruises, Nielssen is in daily communication with the WCC station at Chatham.

He is an operator of keen ability both in telegraphing and in his knowledge of the theory and operation of sets, whether they be spark, arc or tube transmitters, or any type receiver. His first schooling in radio was under the personal direction of Poulsen, inventor of the Poulsen arc transmitter, during the early development of that set. Since then he has engaged in different phases of radio, and as an operator has held many important assignments, including that of chief on trans-oceanic liners.

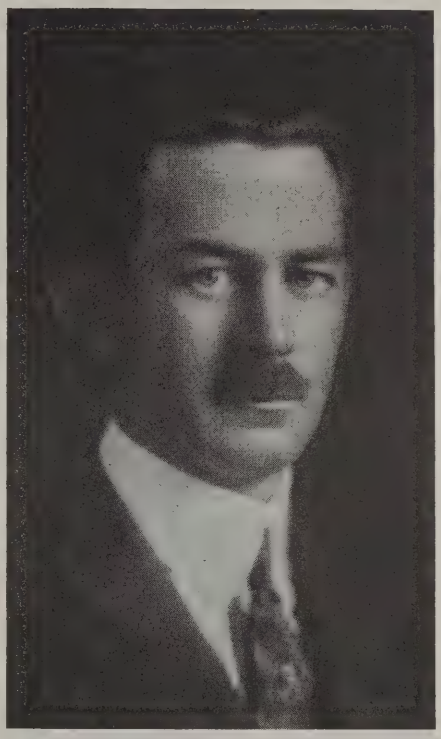
Nielssen is a World War veteran, having served in France with the distinguished Pine Tree Division of the United States Army. He is a polished gentleman, with a personality that attracts and holds friends, among whom his studious nature and acquired education is a matter of comment.

Few know, because of his modest demeanor, that before the war he attended one of the prominent universities in Germany, although not a subject of that country. He is thoroughly conversant with several languages, and is an expert at translating.

* * *

DECORATING the greater number of licenses on the Great Lakes, as well as many on the Atlantic and the Pacific, is the large, bold signature of S. W. Edwards, United States Supervisor of Radio at Detroit. Mr. Edwards is as popular among the radio fraternity as his signature is prominent. He is one of the foremost of the Department of Commerce radio experts and one of the chief advisors of Secretary Hoover.

Years ago he was a ship operator along the Atlantic Coast and between New York and South America. This was before the days of licenses, when an expert knowledge of the apparatus was not an essential, and the old-timers remember him as one of the very few operators of that period who actually knew the "why, what and how" of the sets.



Steffen F. Nielssen, operator on W. K. Vanderbilt's palatial yacht, ARA

There were no radio schools or courses anywhere, but Edwards had graduated from an electrical institute and had mastered the code. Unlike others of the time, he came into the fold, not as operator alone, but scientist as well. He was king among his fellows, and this unique position in the radio field he still retains.

Mr. Edwards is married, has several children and resides in a beautiful home in Detroit.

* * *

OPERATOR J. A. McGOVERN recently performed a remarkable feat in maintaining direct communication with the Chatham, Mass., Station WIM, every day of the voyage of the steamer *Eagle* from San Pedro, Calif., to New York, and again in copying messages from New York while at Portland, Ore., using but one amplifier.

WHAT is thought to be the best long-distance receiving stunt on record was that claimed by Erwin W. Vogel in copying a complete program of press from France while his ship was crossing the 180th meridian in the Pacific Ocean, a distance of 12,500 miles, or half-way around the world.

* * *

SPEAKING of DX work brings to mind a little story about an amateur who made the claim of having received over 12,000 miles on a one-tube set. He explained that he had kept a record of all the stations he had heard and their total distance made up that figure.

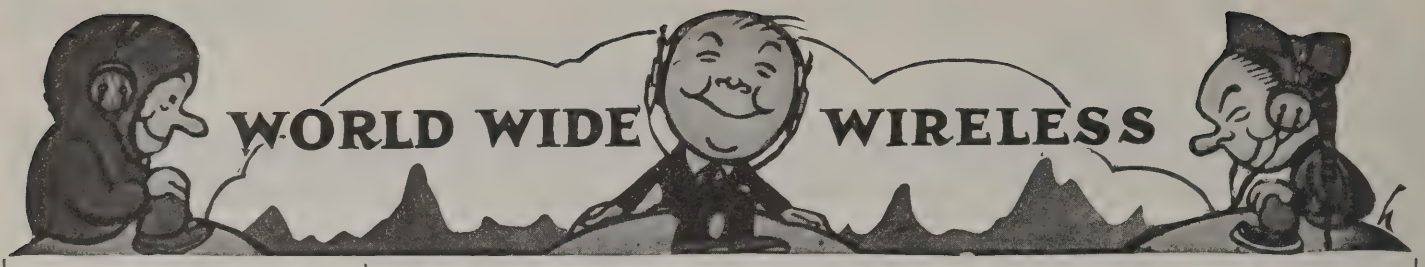
* * *

HERE'S a story that goes the others one better. Bill Wallace, who holds a responsible position in the RCA traffic department, is a popular man to-day, but in years gone by every one in the business from top to bottom knew "Windy" Wallace and old-timers can remember listening to his spell-binding "Static Room" orations with wondering thoughts of, "How does he get away with it?"

Bill—or, on this occasion, let's say "Windy"—that's what we used to call him, and it carries our story better—was in reality one of the best operators of the time. This none can dispute! And no one ever did any greater long-distance work with a crystal detector than he. Nevertheless, he did earn that nickname, and with an apparent desire to make a record that would last until communication with Mars is established, told this:

It was late one night when he was endeavoring to get in touch with a distant station while on a ship in the Pacific. He had just finished his long call and threw his switch to listen, when, lo and behold! there was his own call coming back to him.

Wallace's only explanation was that the signals must have gone around the world several times, and he happened to catch them on one of their flies past him. Some of the men, however, voiced the opinion that the signals went to a nearby planet and were reflected back. Whatever the case may be, Wallace is a champion.



RADIO NEWS FROM ALL OVER THE WORLD

New French Radio Regulations

FRENCH authorities have issued a set of regulations intended to encourage broadcasting and the use of radio equipment by amateur throughout the country. It is provided that receiving sets may be possessed by any citizen of France who will sign a formal declaration, receivable at any post office, stating the kind of equipment used and agreeing that no part shall be taken in the transmission of private correspondence. Sets in the possession of foreigners, or used to receive private correspondence, require individual authorization.

The right to operate transmitting sets will be regulated by the Under-Secretary of the French Postal Services, on the recommendation of a permanent commission upon which public service groups, manufacturers, and amateurs, will have representation. Transmitting sets are to be classified as those intended for establishing private communication; public broadcasting sets; portable sets; sets used for technical experiments, and amateurs' sets.

Wave length standards and other technical regulations will be set up for each class by public authority. The use of amateur and experimental sets will not involve the payment of any fees. Public broadcasting is made the subject of individual contract.

New Italian Radio Co.

ONE of the latest developments is the formation in Italy of a huge radio manufacturing and operating organization at Rome, similar to the Radio Corporation of America and the Marconi Company in England. The new company is to be known as the "Societa Annonima Italo Radio per Servizi Radioelectrici," and is understood to be a consolidation of two older organizations. The authorized capital is seven million lire, part of which is to be used for the purchase of the Italian rights to German and French patents and for the purchase of existing equipment in Italy.

Previous to the organization of this national body—it is agreed that at least 55 per cent. of the stock must be held by Italian citizens—Italy depended upon England, France and Germany for her international radio service. In view of its large colonial possessions situated at great distances from Rome, the need for a high-powered radio communication service is as great as in any country, except perhaps Great Britain.

Radio Telephone in Brazil

THERE are about 8,800 radio telephone receiving sets operating in the Federal District of Rio de Janeiro, Brazil.

Broadcasting of music and entertainment is taking place regularly from the Government station at Praia Vermelha and the Radio Sociedade do Rio de Janeiro. A line is being put up to connect the former station with the Instituto de Musica to permit the broadcasting of concerts.

Staff Commander, H. C. Fish, of the S.S. "Leviathan," at the radio compass through which the location of the ship may be ascertained even when the fog is so dense that the sun cannot be seen

Few licenses have been issued outside the Federal District. The first radio receiving set to be installed in the interior of Brazil was set up recently by employes of the Araraquara railway. It is located at Araraquara, in the state of São Paulo, but picks up broadcasting from Rio de Janeiro and Buenos Aires.

Radio Progress in Japan

THANKS to the national calamity of September the obstacles to the extension of wireless telephony in Japan have been removed. The promise of the late Premier, Admiral Kato, is being carried out. Radio broadcasting will no longer be a vain expectation among lovers of this latest scientific triumph for the commercial possibilities are at last beginning to be appreciated.

Late in July the late Admiral Kato, then Premier, keenly alive to the possible greatness and variety of radio's services, gave his promise to aid private capitalists to introduce radio broadcasting in spite of the fact that in so doing he had to alter the traditional policy of the Japanese Government in regard to everything of the kind. But some of his colleagues in the Cabinet were not of the same opinion. Private interception of military or diplomatic radio messages was feared. Perfect protection of such official words over the air was sought. Before the earthquake of September it was deemed impossible for the Government to carry out the late Premier's promise.

The services of the radio, installed as experiments, were, however, very great during the dark days of the quake. Wireless telegraphy did its brave and meritorious service to give news of suffering Tokio and Yokohama to the outside world.

The relative advantages of wireless telegraphy and telephony over the old systems of telegraphy and telephony, too, have been fully demonstrated since the dark days of the quake. Immense labor and capital have been spent to restore the damaged telegraph and the telephone systems, but only partial restoration has been accomplished so far. The best part of Tokio and Yokohama will have to do without their telephone facilities at least for a couple of years to come. To the popular mind as well as experts this is a clear demonstration of the disadvantages of the old systems in comparison with the wireless systems of telegraphy and telephony.

The Department of Communications is perfecting the radio broadcast-

ing regulations planned for some time past. The chief of the telephone service in the Department of Communications says that the radio broadcasting regulations have been nearly perfected, but that it will be some time before they are fully matured and put in effect. "If," says the official, "all go off smoothly, they will be promulgated within the present year."

Japan's radio age begins actually, if his statement is correct, in a couple of months and radio lovers and students who have been content with their tiny model installations and experimental operations under strict official supervision will enjoy radio's facilities in its fullness. "Unless full interference preventive measures are adopted before permission of broadcasting is granted, trouble will develop at once to mar all enjoyment or pleasure of radio," says one official. "In my opinion that can only be avoided by placing certain limitations on the hours of broadcasting, specifying technical methods of operation and regulating the character of apparatus to be installed. The new regulations are framed so as to cover all these limitations which are absolutely necessary for the success of radio broadcasting."

As far as radio circles in Tokio, which are eagerly looking forward to the day of free broadcasting in spite of their recent grave calamity, are informed, the Japanese Government will permit broadcasting at first in Tokio and Osaka only. If possible, some adjacent towns may be included in the chartered zones. The hours of day and night will be divided into several sections, each of which will be assigned to the different lines of business such as the stock market, the grain trade, the silk trade or the cotton yarn trade. Some special hours will also be assigned to the Government services and the press.

Wallace Morley directing a mob scene in a big production a quarter of a mile away by radio

Uruguay Takes Up Radio

KEEN interest in radio is developing in Uruguay. There are only five houses dealing in radio apparatus in Montevideo, two of whom have only just begun to handle radio goods to any extent. One of these concerns intends to erect a small broadcasting station, since the only station now broadcasting in Montevideo gives concerts very irregularly, making it necessary for the Uruguayan radio fan to depend very largely upon Buenos Aires.

Train Control by Radio

AUTOMATIC train control by radio will be installed on at least one division of forty-nine first-class roads of the country by 1925, it was announced at the opening session of the fourteenth annual convention of the Association of Railway Electrical Engineers.

Radio holds possibilities of intercommunication between moving trains and fixed points for personal wire or phone service and holds more promise of real value in the future than broadcast reception, it was stated.

A German View on Broadcasting

By Dr. Eng. Carl Schapira

AFTER Marconi, twenty-five years ago, made the first successful experiments on the basis of the experiments by Heinrich Hertz, radio science soon developed into an everyday necessity in the various countries. This development, however, was not accomplished in the same direction by the different countries. In Germany the World War was responsible for directing radio activities into the field of replacing lost cable and telegraph communication facilities by radio telegraphy. America, to the contrary, was in such financial condition as to always satisfy the continuous demands of their people for sport and pastime. The general prosperity in that country very favorably influenced the development of radio art. People living in the interior of the country and far away from the centers of culture and intellectual education naturally were eager to pick up any new means to get in contact with sources of this kind. It was therefore not surprising that within a very short time an enormous amount of broadcast receiving apparatus could be disposed of to the public.

Compared with this what is the situation in Germany?

In the first place, after the war this country was obliged to use radio as a public service on a much greater scale than in any other country of the world.

Radio equipped car used by the Berlin Police Department

It is a well known fact that with the exception of the English cables, we only had at our disposal for direct overseas communication the stations at Nauen and Eilvese, thereby placing the radio oversea route in Germany in a more important position than in any other country in the world. This in turn again made it a foremost duty of the Government to protect the users of this means of communication, more so than in any other country, against misuse by outsiders in copying messages not intended for them. Besides the oversea communication, also the Inter-European traffic routes were extended or replaced by radio communication. The Government-owned station at Koenigswusterhausen, assisted by Nauen and Eilvese, is now taking care of a considerable amount of traffic exchanged with Russia, Spain, Roumania, Italy, England, Esthonia, Bulgaria, Hungary and Jugoslavia. It is to be understood that these routes are equally entitled to the protection as described above. At the expiration of the war, these communication facilities enabled us to immediately reopen exchange of traffic with other European countries, at the same time creating a source of revenue for the Government.

A unique feature of the radio art in Germany is the "Blitzfunk" service. At record speed messages are transmitted by means of the electric waves which would be impossible on our overcrowded wire system, the exten-

sion of which would be out of question on account of the present financial situation in Germany. This service not only accommodates commercial and industrial firms in the transmission of their most important and urgent messages, but at the same time, means a new and considerable revenue for the Government.

Another feature which, however, may not be as well known as the one above, is the multiple telegraphy and telephony by means of radio over one single wire. More than fifty telegraph and telephone lines are being operated without going to the expense of erecting new wire lines. Without interfering with the messages or telephone conversations carried over the lines by continuous current, further messages and conversations are being transmitted, often two and three at a time, along these lines by means of radio.

As was the case in all other uses of radio the use of broadcasting in the first place had to serve as a public utility and as a means in furthering the interests of the Government. Sport and pastime are signs of prosperity. Aside from the American inclination for sports and pastime, we did not have the necessary funds and, last but not least, the Government had to be careful in taking advantage of every means of revenue.

For development of commerce and increase of profits the original broadcast service, called Commercial Broadcast Service was inaugurated.

Instead of producing musical entertainments and recitals, the most important commercial news was broadcast immediately upon receipt. This news, however, had to be procured by an organization, which incurred considerable expense. This organization, the "Eildienst G.m.b.H," has numerous representatives in foreign countries. Such a system naturally requires payment of certain tolls and must be protected against misuse by outsiders.

Even an amateur knows that radiotelegraphy does not allow an unlimited use of the air, since each message is transmitted on a certain wavelength. In America only the larger stations reserve a certain number of wavelengths. In Germany, however, a great number of stations are always in operation and the scale of wavelengths extends way down to the small wavelengths used by army, police, aviation and navy stations.

At last, and to the satisfaction of all concerned, it became possible to inaugurate a public broadcasting service to which anybody can subscribe upon payment of a yearly fee of 25 marks. Unfortunately, this service met with objections in the beginning and was misused by certain people to the disadvantage of the public interests.

It was claimed that America does not have any Government control, that no tolls are collected by that Government and that anybody can sell apparatus without considering the production of musical entertainments, nor who pays for same. I am convinced that the reader will agree with me in my opinion of supporting the Government authorities against theft of broadcast matter and by providing the necessary funds for entertainments, concerts, etc.

How can a broadcasting station produce a satisfactory program without being provided with the necessary

Donald MacMillan operating his set aboard the "Bowdoin"

funds? To have one of the large firms—as in America—provide for the concerts free of charge and have the other firms—as in America—be the dodgers is impossible in this country. The apparatus sold in this country is too small for such an enterprise and besides the number of broadcasting stations necessary for more than twelve centers of cultural districts would undoubtedly leave no room for any profit. One only needs to consider the broadcasting situation in England. In that country it was assumed that the same system as in America could be established. Now they are trying, by all means, to obtain more paying members of the broadcasting service.

Medal of Honor to DeForest

THE many honors that have been visited upon Dr. Lee DeForest were signally added to when he was presented with the 1922 Medal of Honor awarded by the Institute of Radio Engineers.

The presentation speech was made by Gen. George O. Squier. The ceremony took place at the Engineering Societies of New York.

Dr. DeForest called his invention the audion after the Latin word "audio," to hear, and the Greek word "ion," meaning wanderer, thus suggesting tiny carriers of the electrical current passing at an enormous speed through the electrodes of the lamp.

The vacuum tube has been deemed by many scientific historians to be the greatest contribution to a great scientific era. It has revolutionized communication; it made possible long distance telephony and is the basis on which the entire art of radio broadcast and reception rests.

A Forecast of Radio for 1924

By DAVID SARNOFF

Vice-President and General Manager of the Radio Corporation of America

RADIO as a "plaything" has given way to radio as a household necessity. The radio public today must be served, not merely amused. With this great increased purpose for radio there naturally comes a corresponding decrease in toleration for some of its temporary shortcomings.

Nineteen-twenty-four, will demand of radio a marble and terra cotta finish for the structure already well founded.

Distribution, on the average, will seek a higher plane and a more stabilized form of operation. The radio dealer will show a greater effort on the whole to build for the future. The industry will grow rapidly during the next few years and the wise dealer will appreciate that in time it will reach a point where new business will flow in a steady stream, to those who measure up by salesmanship and service. The good will and prestige built now will make for permanent customers and a well balanced trade.

Broadcast receivers, will provide greater efficiency, better quality of reproduction, more selectivity, purer amplification and greater sensitiveness. The better grade receivers will eliminate the need for an outdoor antenna and even hide away the loop. Radio sets will be housed by cabinets that are beautiful as pieces of home furniture as well as being completely self-contained receivers.

Broadcast transmission, improving markedly with each passing month will make even greater advances during 1924. This year will undoubtedly take a forward step in the direction of minimizing the interference from the multiplicity of broadcasting stations, spark interference and other sources.

This is a comprehensive schedule of development for radio in 1924. It is being brought about by joint action of the public which expects present deficiencies to be eliminated or improved upon by leading manufacturers whose research, engineering and manufacturing facilities will keep pace with the requirements of this rapidly advancing art and make such improvement possible.

Bergen Station Progressing

APPARATUS for the radio station which is to be built at Bergen, Norway, has been received in that country, according to advices to Washington from Consul George N. Ifft, and preliminary tests have assured the Government of its efficiency. Because of the failure of an appropriation for duplex apparatus which would enable the transmission of messages both ways simultaneously, and the failure of the plan to establish a telephone line between Bergen and the Rundemanden Radio Station, the chief use of the new station will be for the transmission of wireless communications to ships at sea.

Radio Concession in Russia

THE People's Commissioners in Moscow are reported to have granted a radio concession to a French company for the first time. While full particulars are lacking, the concession is for the exploitation of a radio telegraph transmitting and receiving station. According to the agreement, the French company is to build the station for the "Radio Trust" of Moscow, and will assist in running it.

Effects of the Aurora Borealis on Radio and Wire Communication

By G. ARNOLD EDWARD,
Radio Inspector, Canada.

REFERRING to the editorial in the August issue of THE WIRELESS AGE, wherein it was stated that no definite information has ever been available as to whether the Aurora had any effect on radio communication, I would like to mention that during the last season of the Aurora I made a great number of observations in this respect, and found that when it attained any appreciable intensity, whether visible or not, its presence could be detected by very rapid fading as the Aurora waves came over. If the Aurora persisted continuously all evening the effect was as though a blanket of silence had been placed over radio communication.

The effect is more noticeable on long distance continuous wave communication. This, of course, includes phone, as we are 800 miles from WGY, which at the time the observations were made, was our loudest station. To a great extent the signals of the commercial stations, working on 600 meters, were considerably weakened.

I might mention in passing that a part of my regular duties is to make Aurora observations on submarine cables and landlines, noting current and visibility intensities, these observations being eventually used in connection with those of Dr. MacMillan's for research work.

One evening I remember in particular, the Auroral currents reached a pressure of over 300 volts on a 180-mile cable and during this period not a single carrier wave from any radiophone station could be heard, nor could the harmonics from Glace Bay (30KW. CW.) 24 miles away be noticed.

Paul Sellenburger of the Naval Observatory, operator who sends out the time signals twice a day from Arlington. The Naval Observatory is frequently in touch with France and Germany

Some members of Paul Whiteman's Band and the input apparatus used to broadcast his music from the "Leviathan" at her dock

New Broadcasting Station at Johannesburg

COMPLETION of a large broadcasting station at Johannesburg, South Africa, will be accomplished soon after January 1, 1924. An increasing demand for radio sets is expected to follow.

French Time Re-broadcast in England

STATION 2ZY, Manchester, England, one of the chain of stations maintained by the English Broadcasting Co., now is re-broadcasting time signals from the Eiffel Tower, Paris. A special receiving antenna was installed at 2ZY for the purpose, and a receiver with a powerful amplifier and a loud speaker is used to broadcast the signals. At 11:45 p. m., Greenwich Mean Time, the loud speaker is placed before the microphone of the transmitter, and the time signals from FL thereby re-broadcast on 385 meters. It is calculated that not over 1/500th part of a second is lost in re-transmission.

Radio Sets in Denmark

DENMARK now has officially licensed 3,109 private radio receiving sets. School pupils rank first with 473; commerce, shipping, and industry second with 448; office and store employees have 354; artisans, 341; electrical contractors, 334; and laborers, 324.

Junk This Radio Jargon

Let's Talk for the B.C.L. to Comprehend

By George H. Clark

THERE is nothing more needed in radio today than a large dose of common sense. With the advent of the radio listeners, knowing little of the theory of their new play toy, and therefore credulous in the extreme, has come about an era of more or less deliberate hokum in radio which is doing the art a lot of harm.

The press of today is filled with a

An era of hokum in radio has come about

weird jargon as incorrect as it is weird, that would lead the newcomer to believe that variometers and duolateral coils and honeycombs and spiderwebs are all as different as Ford tractors and Peach Melbas. Radio enthusiasts are led to speak of condensers as 47-plate and 23-plate devices, which is as correct as describing a coin by saying it contains silver, and which is reminiscent of the real old days, when nothing was known about electricity, and when a condenser was described as a "quart jar." Today such loose and in cases incorrect terminology is absolutely indefensible.

Coils should be described in terms of their inductance in millihenries. Condensers should likewise be referred to in terms of their maximum capacity. Further reference to the two devices as variometers, or variable condensers, is permissible. All this has been standard in the radio art for many years. The newcoming jargon is intended definitely to confuse and fool the vast army of radio beginners. There is no defense for this.

Radio in general is simple. The laws that govern its circuits are all well known and there are not many of them. Dr. Austin, the tireless physicist of the Navy Department, has done much to make the fundamentals of radio intelligible to anyone who can read ordinary English, and Professor Pickard, pioneer radio inventor, has done much with his tables which make radio calculation easy. But against these few is the vast army of modern publications which would make it appear that a variocoupler was a piece of apparatus having no feature in common with any other form of inductance. Perhaps the publications have not deliberately aimed at confusing the public, but long contact with the puzzled experimenters who cannot connect up a circuit containing honeycomb coils because their only available diagram shows cylindrical ones has made me clearly see that there must be some conspiracy against the beginner, for no one is trying to lead him out of the obscurity where he is mired.

The magazines are full of freak data concerning antennas. We read of bedspring antennas; of umbrellas as antennas; of winding a few turns of wire around one's waist and going out as one's own tower and aerial. All these freak antennas convey to the beginner the idea that each has peculiar and special merits, whereas the actual facts are, that each may best be described as having its particular defects.

The actual facts are that it is almost impossible not to receive radio signals, if we connect our receiver to any metal object whatever, as long as it is ungrounded. Radio waves are constantly striking our electric light lines, our telephones, the steel structures of our buildings, the Brooklyn Bridge, the "L" structure, the third rail (although no one yet has suggested plugging in on it), every fence wire and metal clothesline in the country; every tree! Some of these are good antennas, some are bad. But the general law that Dr. Austin has pointed out is that the antenna must be well insulated, that it functions better the higher it is, and that for a given wave length it has a certain best length.

What is an antenna? Any insulated conductor which is above ground and which you connect to a receiver. Of course a bedspring is an antenna, and you would get as good results if you ran the lead from your set under the bed and did not connect it at all. Of course the electric light wires are antennas, to some extent. But if a bedspring antenna will give you signals, a wire running from your attic window to some tree a hundred feet away will give you very much better signals! There is no doubt about this. It is clear and well-known.

Of course two nails driven in a tree will pick up signals, but if you forget the partial conductivity of the tree and insulate your lead wire at the nail, using the tree as a tower and the wire as an antenna, your signals will be many times louder. So I leave this message. Any wire or metal object that is insulated will receive radio messages. The best antenna is a single wire, run as high as you can run it, and with a length approximating a hundred and fifty feet overall. Mystery here is replaced by common sense.

When we come to circuits, here is confusion! Many years ago, when only the crystal detector and the electrolytic were known, and when Armstrong was playing ball in the back lot, a book was gotten up entitled, "One hundred circuits." Out of this number, twenty-seven were actually inoperative, for simple reasons such as the telephone short circuited and things like that. The others had all available permutations and combinations written into them, in one case the stopping condenser being on the right of the detector and in the next on the left. There were in all only eight circuits that were at all different. Today, the vast number of circuits that clutter our radio press are merely repeating with Armstrong's aid the mazes of the past.

Professor Pickard has been in radio since radio began. He knows several things that lots or others do not know. One thing he possesses is common sense. He was considering the Armstrong super-regenerative circuit one day, and he noted that coupling between primary and secondary could be

What is an antenna, anyway?

obtained magnetically, capacitatively, by direct coupling, and so on. Likewise the feedback principle could be attained by the ordinary feedback coil, by plate variometers, by the Western Electric two-condenser method, and so on. Lastly, the grid could be biased in different ways. Combining these various degrees of freedom by the ordinary arithmetical laws of combinations, he obtained almost a hundred ways of setting up the Armstrong circuit. More than that, he actually set them up, and found that all were equal-

(*Continued on page 72*)

How to Design Inductance Coils

Constructional Data for Winding Inductance Coils of Known Value

By Samuel C. Miller

A PROBLEM that one is very often confronted with in the construction of a radio set is the design of a coil having definite characteristics. For example, in the case of the tuned grid circuit of a tuned transformer-coupled radio frequency amplifier, a wavelength range of 100 to 500 meters is desired. When using the standard coils purchased on the market, the lowest wavelength that can be obtained is about 200 meters. As there are a number of amateurs who wish to receive on a wavelength as low as 100 meters, a special coil must be designed which will allow the tuning in at the low wavelength desired.

There are two methods of attacking the problem to obtain the required coil. One method is by winding and rewinding one coil after another until the correct number of turns is found which will give the necessary inductance. The other method is to first calculate for the unknown factors and then to build the coil from the results obtained. It is not necessary to say that the second method is the more feasible one, not only because of the time, material and labor saved, but also in the fact that the problem has been solved along engineering lines.

Where it is desired to find a coil which will give a wavelength range of 100 to 500 meters, there is found that a certain amount of material is on hand. This includes a .001 microfarad variable condenser which has a minimum capacity of 35 micro-microfarads and a maximum capacity of 1,000 micro-microfarads (.001 microfarad): a length of two-inch tubing and some No. 22 double silk covered wire. Before the dimensions and number of turns of the coil can be found it is necessary to first find the inductance required which, when used in conjunction with the variable condenser will take in the range of 100 to 500 meters in wavelength.

The simplest formula for wavelength using common units is $\lambda = 59.6\sqrt{LC}$ where λ = wavelength in meters L = inductance in milhenries and C = capacity in micro-microfarads. As both the minimum wavelength and capacity are known, the first step is to solve for the inductance, using as the factors λ and C the lowest wavelength and the capacity at zero setting of the condenser. To solve for L, the above formula is converted into $L = \frac{\lambda^2}{59.6^2 \times C}$ and with $\lambda = 100$ meters and C = 35 micro-microfarads $L = \frac{100^2}{59.6^2 \times 35} = .08$ millihenry. With an inductance of .08 millihenry required to give a wavelength of 100 meters at zero setting of the condenser, then this value of inductance must also be high enough to give a wavelength of 500 meters at the maximum setting of the condenser. Solving for wavelength $\lambda = 59.6\sqrt{LC}$ with L = .08 millihenry and C = 1,000 micro-microfarads, then $\lambda = 59.6\sqrt{.08 \times 1{,}000} = 523$ meters. This is a little higher than that desired, but is satisfactory for practical needs. A coil must therefore be designed which will have an inductance of .08 millihenry.

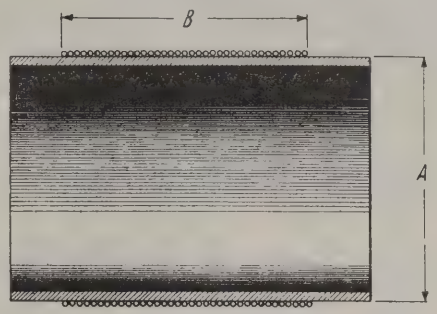


Figure 1

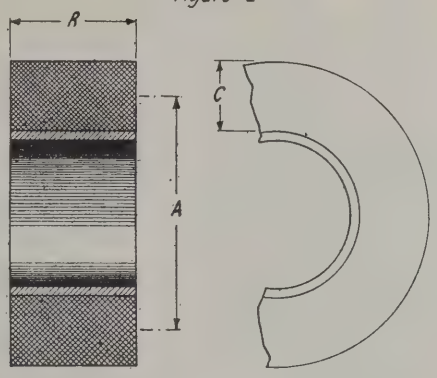


Figure 2

Single and multi-layer coil design

The inductance of a coil depends upon a number of factors and for accurate solution it used to be quite a tedious affair to calculate such a problem until Professor Hazeltine presented his empirical formula. This formula is both accurate and simple to handle as it uses common units for its factors. Professor Hazeltine's formula for inductance is $L = \frac{.0002\ A^2\ N^2}{3A + 9B + 10C}$ where L = inductance in millihenries; N = number of turns; A = mean diameter in inches (see figures 1 and 2); B = axial width of winding in inches and C = radial depth of winding in inches. In a single layer coil as in figure 1 C is so small a factor that it can be entirely neglected; whereas in a multi layer coil as in figure 2 C becomes an important factor and must be taken in consideration for accurate results.

Continuing with the example, the material on hand is a length of two-inch tubing and some No. 22 double silk covered wire. Referring to the formula $L = \frac{.0002\ N^2\ A^2}{3A + 9B}$ (C is neglected as this is going to be a single layer coil) there are three factors known: L = .08 millihenry, A = 2 inches and the size of wire which is No. 22 double silk covered. This leaves the factors N and B unknown and to be found.

The best method of attack with these two factors unknown, is to pick at random a value of N which also gives B as the size of the wire to be used. This will give all factors needed to solve the problem and by using the formula, a value of L is obtained which may be lower or higher than the desired inductance. After two or three tries the correct number of turns can be obtained, which will give the desired inductance.

In the example, 32 turns is taken at random for N. In order to get B or axial width of winding, it is necessary to refer to Table II. Alongside of No. 22 B. & S. gauge wire and below double silk, it is found that 32 turns per inch is obtained when using this kind of wire. Solving $L = \frac{.0002\ A^2\ N^2}{3A + 9B}$ with A = 2 inches, B = 1 inch and N = 32 turns then

$$L = \frac{.0002 \times 2^2 \times 32^2}{(3 \times 2) + (9 \times 1)} = \frac{.818}{15} =$$

.055 millihenry. As the desired inductance is .08 millihenry, the value of N = 32 turns taken at random is too small and must be increased. This time with N = 44 turns and B = 1⅜ or 1.375 inches.

$$L = \frac{.0002 \times 2^2 \times 44^2}{(3 \times 2) + (9 \times 1.375)} = \frac{1.54}{18.3}$$

TABLE I

Turns per 1"	20	24	28	32	36	40	45	50	55	60	65	70	75	80	90	100	110	120	130	150	Diam. of Core
	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	25	27	30	32	38	1 "
	7	8	9	10	12	13	15	17	18	20	22	23	25	27	30	33	37	40	43	50	1¼"
	8	9	11	12	14	16	18	20	22	24	26	28	30	32	36	40	44	48	52	64	1½"
	9	11	13	15	17	18	21	23	25	27	29	31	33	36	41	46	50	55	60	69	1¾"
Feet	11	13	15	17	19	21	24	26	29	31	34	37	39	42	47	52	59	63	68	79	2 "
of Wire	13	16	19	21	24	27	30	33	37	40	43	47	50	53	60	67	73	80	87	100	2½"
per	16	19	22	25	28	31	35	39	43	47	51	55	59	63	71	79	86	94	102		3 "
Linear	19	22	26	29	33	37	41	46	50	55	59	64	69	73	82	92	101	110			3½"
Inch	21	25	29	33	38	42	47	52	57	63	68	73	79	84	94	105	115				4 "
	27	32	37	43	48	53	60	66	73	80	87	93	100	107	120						5 "
	31	38	44	50	56	63	71	79	86	94	102	110	118	126							6 "
	37	44	51	59	66	73	83	92	101	110	119	128	138								7 "
	43	51	60	69	77	86	96	107	118	129	139	150									8 "
	47	56	66	75	85	94	103	118	129	141	153										9 "
	52	63	73	84	94	105	118	131	143	157											10 "

= .084 millihenry. This value is close enough for practical purposes to the desired value of .080 millihenry.

Having obtained all the factors necessary for making the required coil, the number of feet of wire used can also be found by referring to Table I. Reading across the top "Turns per 1 inch," the number 45 is obtained, which is only one more turn than the actual number required. In the right hand column under "Diameter of Core," 2 inches is found to be the tube diameter to be used. On intersecting 45 turns and 2 inches, 24 feet is directly obtained.

In conclusion, the results of the above example show that an inductance of .08 millihenry combined with a .001 microfarad variable condenser will give a wavelength range of 100 to 500 meters. And that a coil two inches in diameter wound with a single layer of No. 22 double silk covered wire will give the required inductance of .08 millihenry. Also the required length of wire for winding the above coil is 24 feet.

TABLE II

Size B. & S. Gauge	Turns per Linear Inch Enameled	Single Cotton	Double Cotton	Single Silk	Double Silk
20	29	25	23	27	26
21	32	28	26	31	29
22	36	31	28	34	32
23	41	34	31	38	36
24	45	37	33	42	39
25	51	41	36	47	43
26	56	45	39	52	46
27	64	49	42	57	52
28	71	54	45	63	56
29	79	58	48	70	62
30	88	64	56	77	67
31	100	69	57	85	72
32	112	75	60	93	78
33	134	81	64	102	84
34	140	87	68	112	91
35	156	94	73	120	97
36	173	101	78	130	104
37	201	108	84	141	110
38	225	115	89	151	117
39	256	122	95	163	123
40	288	130	102	178	129

In the same manner in which the above example has been solved, other problems can be dealt with either for single or multi-layer coils when using the formula and tables herewith given.

KGO on the Pacific Coast

(*Continued from page* 23)

comprises and includes all the best that has been developed at WGY on the Atlantic coast after months of careful study. Located on a wide expanse of free land in the outskirts of Oakland, directly across the sea-filled crater of San Francisco Bay from the city which is the key to the Orient, it has an ideal location.

The new station is rated as a 1,000-watt unit, with duplicate transmitters, so that one may be utilized as an emergency set in case of need. All of the equipment is "special stuff" in the words of the constructing engineers, who include California staff men as well as supervising engineers from the main plant of the company at Schenectady, N. Y.

The studio building, located on a main artery of traffic which links with the famous Lincoln Highway, the national pathway to San Franciso, is one thousand feet away from the operating room and transmitting point. All construction is steel and concrete. The studio itself is a two-story concrete, gray-appearing artistic little affair, surrounded by lawns which remain green the year around and flower borders that blossom twelve months in the year.

In this building is housed the storage battery units, an office and reception room, with a main and auxiliary control room, an artists' waiting room, and other accessory accommodations. The second floor is devoted in the main to the studio itself with its microphonic and amplifier connections to the operating room and the official "listening room" in which necessary outside reception is accomplished.

At the far end of the acreage devoted to this extensive plant—1,000 feet distant, has been erected the giant transmitting masts, the power house and generator equipment, the control and switching panels that handle the powerful transmitting circuits.

The equipment here is General Electric throughout. Huge pliotron tubes—oscillators, modulators and amplifiers, 2,000-volt generators for the amplifier circuits, the distribution panels, the huge rectifiers—all are based on concrete and designed with a view of permanent operation. Two complete equipments have been installed in this building, one at each end of the operating room. In addition there is the usual 600-meter C.W. outfit for ship communication in answering distress and other signals.

The technical equipment includes a dummy antenna for testing, and a multiple tuned antenna, the latter being tuned both inside and outside the operating room to obtain maximum efficiency. Two operators will be constantly on duty at the operating room and two at the control room in the studio building, with other assistants whose duties will include the social phases of the entertainment work.

CLANG! The iron-barred door was closed; the long steel bar was shot home; the key was turned in the lock; the swiftly retreating footsteps of the Guard gave notice that he was on his way to report to the Warden that Number 186 was safely locked in his cell for the night. The Warden believed the report of the Guard but the Guard was mistaken! Number 186 was not in his cell! He was a thousand miles from the New Hampshire State Prison! He was in Chicago listening to the orchestra of the Drake Hotel! A few minutes later he was in Davenport, Iowa, "Where the West Begins!" Another moment and he was in a foreign country, Cuba! Then he made a swift trip to Pittsburgh where he heard Lloyd George! He dropped in at the White House and heard a few words by President Coolidge! He went to Schenectady and enjoyed the drama, "Shavings!" He enjoyed the music furnished by the band of the Canadian Royal Highlanders at Montreal!

In the morning, the Night Watchman, at the end of his tedious round, reported to the Warden that Number 186 had remained safely locked in his cell for the entire night!

In the March number of THE WIRELESS AGE Number 186, a "lifer," will tell you what radio has done and can do for the unfortunates in our prisons.

Jack Barnsley has become a familiar name in the Radio World, and a romantic interest attaches to the story of the young amateur wireless operator whose receiving set brought to his ears the call of MacMillan's Arctic Party, far north of Labrador, who were trying to reach with their own radio waves some waiting and listening station back in the temperate clime. In the March number of THE WIRELESS AGE Jack Barnsley tells how he caught that radio wave, and how by devoted attention to his little station he continued to serve as the link connecting the MacMillan party with their home-land. This story, ingenuously and modestly told by its principal character especially for THE WIRELESS AGE will transport the reader into this British Columbian Station to listen keenly through the long midnight watches with its young owner for those thrilling messages from the land of ice and long darkness.

The Wireless Age Reflex

Loudspeaker Volume With One Tube

By John R. Meagher

Author of "How to Make a One-Tube Reflex Set That's a Knock-Out"

NOTE—Certain patent owners permit amateurs to make up their own radio devices for their own use and not for sale. Relying on this policy this article gives suggestions to aid amateurs in their experimentation, but no license under patents is to be inferred from the publication of these suggestions. The license rights exist only through the generosity of the patent owners and if any owner should object, the amateur should refrain from using the particular invention involved.

REFLEXING, it is interesting to note, although nearly as old as the vacuum tube itself, has only recently been applied with any degree of success to receivers of amateur construction. For the dual use of tubes never proved popular with the old-time amateur as there was no method of obtaining good radio frequency amplification at 200 meters; and commercial engineers were not interested in it as to them the slight additional cost of a straight cascade amplifier was of no importance. Therefore both interest and experimentation lagged.

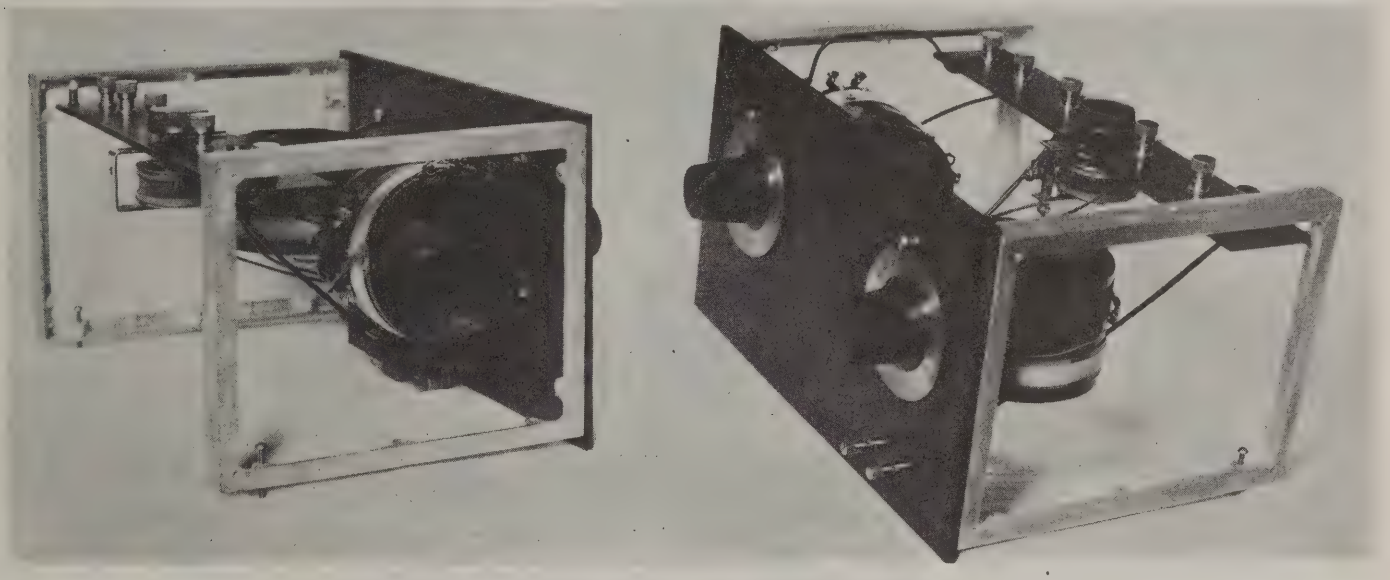
But a year or so ago when "broadcasting" fans first heard about reflexing and the claims that with it, it was possible to secure the result of two tubes with only one; four tubes with two and six tubes with only three, they fell over themselves in a mad rush to make reflexes.

Now at that time there were, unfortunately, only untuned transformers available for inter-tube coupling at radio frequencies and these while suitable for use with vacuum tubes, proved not quite so good in single tube reflexes where a crystal "detector" was shunted across the secondary. For that reason and through careless design of multi-tube reflexes, the majority of reflex receivers failed to "reflect" properly. Therefore after this sudden boom and rather disheartening crash, the market in amateur made reflexes dropped and on the whole they were thereafter viewed as a sort of "interesting, if true—but not for me" subject.

* * * * *

About a year ago we did a great deal of experimental work on tuned radio frequency amplification and reflexing. And when we say a "great deal" we mean just that: Three solid months of work from about four o'clock in the afternoon to four o'clock in the morning gave us a pretty good idea of the relative merits of all types of radio frequency amplifiers and the limitations of reflexing.

One of the receivers we worked out was a two-stage radio frequency amplifier, without potentiometer or balancing controls, that did not oscillate! But that was not so great an accomplishment as the plate inductance had only 8 turns and any—get that—ANY—radio frequency amplifier for broadcasting wavelengths with so few turns in the plate circuit cannot possibly amplify as much as one in which the plate circuit is either tuned or else has an inductance whose impedance is greatest in the center of the wavelength band and the design of which is such as to make it broad or aperiodic over that range. (To digress a moment: Who started the generally accepted definition of aperiodic as a "winding whose natural frequency is lower than the lower end of the range?" And who started the bunk about a step-up ratio and its benefits, and then so conveniently neglected to mention the extremely low voltage drop across the alleged "aperiodic" primary? And who started that stuff about the secondary tuning the primary? If that person will step up we sure would like to hold a few moments conversation with him).



Front and back views of The Wireless Age Reflex Receiver

In experimenting we found that substituting a tuned transformer for the untuned one in a single-tube reflex made a vast difference—indeed an amount that can hardly be appreciated.

Further, we found, by keeping the inductance coupling between plate and grid circuits as low as possible that a real plate inductance could be used. At first, in carefully shielded sets, we used as many as 60 turns on the primary of the plate-detector transformer and with a UV-201-A tube, found no difficulty in keeping the tube from oscillating.

However, in receivers of less elaborate design it was found well to reduce the number of turns on the plate coil in order to minimize the possibility of self-oscillation. (The receiver to be described has only 20 turns.)

* * *

It is then these experiments that

for the background for "THE WIRELESS AGE Reflex," a simple, easy-to-make, inexpensive one-tube set that will generally operate a loud speaker 30 miles from a good station. It is a set with which a transmitter almost 900 miles distant has actually been heard on a loud speaker with a similar set, a station in California has been received in New Jersey!

THE CIRCUIT

Figure 1 is a pictorial representation of the exact circuit. The antenna inductance is untuned and consists of a coil placed in close inductive relation to the grid inductance—which is a variometer. The plate winding is a coil placed in close inductive relation to the crystal tuning element, also a variometer.

Thus it will be seen that two radio frequency transformers are used, each being composed of a variometer as the secondary and a small coil wound on or near the variometer as a primary! That is, the transformers, instead of being tuned with condensers across the secondaries are variometer tuned.

The action of the reflex circuit is generally well known, but briefly described the incoming radio frequency impulses are transferred to the grid circuit from the antenna; they are amplified by the tube at the original radio frequency, then transferred to the crystal rectifying circuit, where, after being rectified, they are retransferred to the grid circuit of the tube and amplified at audio frequency by the "step-up" amplication of the audio-frequency transformer and by the amplifying action of the tube—finally being made audible in the headset or "speaker" connected in the plate circuit.

The effect of tuning the secondaries to the frequency of the energy present in the primaries is to increase the resistance of the primary circuits to some extent. This increased resistance tends to prevent self oscillation of the tube. This is the method used in Austin's "sensitizing circuit" described in E. E. Bucher's "Practical Wireless Telegraphy" and reappearing in identical form in the "four circuit tuner." Unfortunately, in our reflex, we cannot take full advantage of this increased resistance effect in the control of self-oscillations as our tuned secondary is coupled to the plate and not the grid circuit and the effect of increased resistance in the plate circuit is not as great as the same increase in the grid circuit. However, we hope to develop something good along this line in the not too distant future.

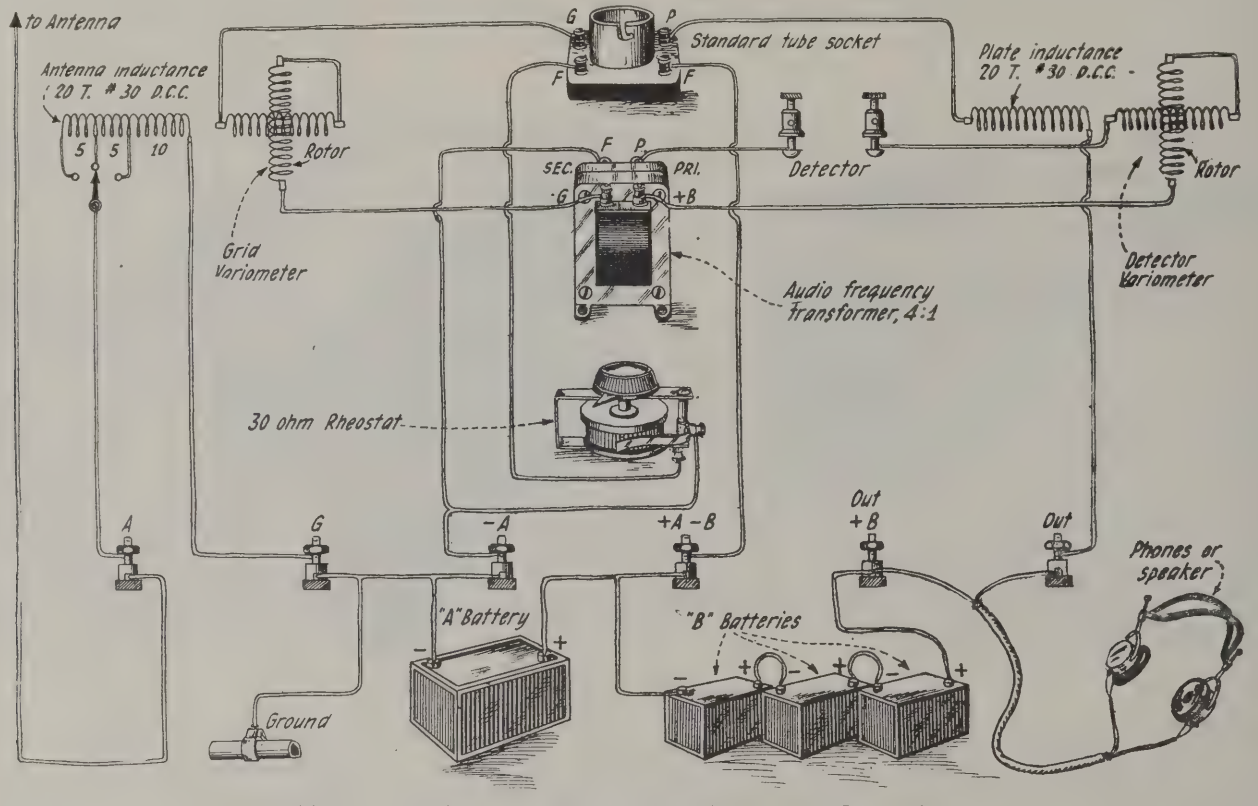


Figure 1—Pictorial circuit diagram of The Wireless Age Reflex Receiver

CONSTRUCTION

First arrange the coils on the variometers; on these pictured a strip of paper was wound over one side of the stator winding and the primary coil wound on top of the paper. The antenna coil has 20 turns tapped at 10, 15 and 20 for long, medium and short aerials, respectively. The plate coil has 20 turns and is not tapped. The wire is No. 30 double cotton covered and the ends are secured in small "anchor holes" drilled in the stator form. The direction of winding is the same as the stator coil and the connections to the coil should be similar to those shown in the diagram.

The front and terminal panel should be drilled in accordance with the panel layouts; making changes, however, for other apparatus.

We would suggest that the panels be grained on both sides as a dull black satin is neater in appearance than a shiny black which shows up every finger mark.

Mount the variometer transformers and the tube socket on the front panel and the rheostat and binding post on the terminal strip. Arrange both on two Quinby "radio" aluminum frames as shown in the illustrations.

Then wire the parts according to the diagram, using No. 18 wire run in cambric tubing.

ANOTHER ARRANGEMENT

If the antenna is short and has a low value of capacity to ground, the antenna inductance may be eliminated and a fixed condenser of .00025 mfd. capacity connected between the antenna post and the grid of the vacuum tube. Results are usually better with this arrangement.

Mr. R. W. Weeks, radio editor of the *Arizona Gazette*, a paper in which we ran a description of a somewhat similar receiver, writes that by con-

necting one side of the detector circuit to ground he obtained a considerable increase in signal strength. He notes, however, that on a few of the receivers this connection increased the tendency toward self oscillation. This checks up with our own experiments and we believe it is usually best to neglect this connection. However, it is such a simple matter to connect a wire from the ground to either terminal of the detector variometer that everyone should try it.

The Crystal Rectifier

It is quite necessary that the crystal stand and mineral be of such design that there is no need for tedious search of a "sensitive" spot, and that once made, an adjustment will stay put for some time. In this connection the synthetic crystals are most satisfactory; being "sensitive" all over and capable of handling a good deal of current—an important point in a reflex receiver.

Personally we always got along well with good Galena and a sharp contact; a fist full of the mineral cost us only 15 cents in the old days and we found numerous good pieces in it. We usually mounted the stand firmly on a solid wall and ran two short separated leads to the receiver. Once set, jars to the table or instrument did not affect the mineral adjustment. Such an idea could well be used with "The Wireless Age Reflex" and in conjunction with a good synthetic crystal it is doubtful if anyone would have trouble with this part.

Operation

With the receiver finished, connect the "A" battery to its terminals on the binding post strip and place a UV-201-A or other vacuum tube in the socket. Turn the rheostat around until the tube filament glows or lights at its usual brilliancy.

Connect the "B" battery, the phones, the antenna, the ground and last, but by no means least, the crystal "detector" to their respective binding posts. Do not forget to connect the ground to the negative filament.

Be reasonably sure that some local station is on the air at the trial and no trouble will be had in turning the two dials to the best points and adjusting the crystal contact for best results.

After a few stations have been tuned in the dials should be adjusted; for instance, if a short wave station is heard with the left hand dial at 20° and the right hand dial at 160°, the latter should be loosened and turned on its shaft until the indicator is in line with the 20° mark.

The dial readings may be recorded so other members of the family will have no bother in hunting for local or DX stations.

* * * * *

Next month we will give instructions on how to build this receiver over into a three-tube set; having one stage of tuned radio frequency amplification, a vacuum tube detector; one stage of reflex audio frequency amplification and one stage of straight audio frequency amplification—a really excellent long distance receiver.

Layout of front and terminal panels with dimensions for drilling

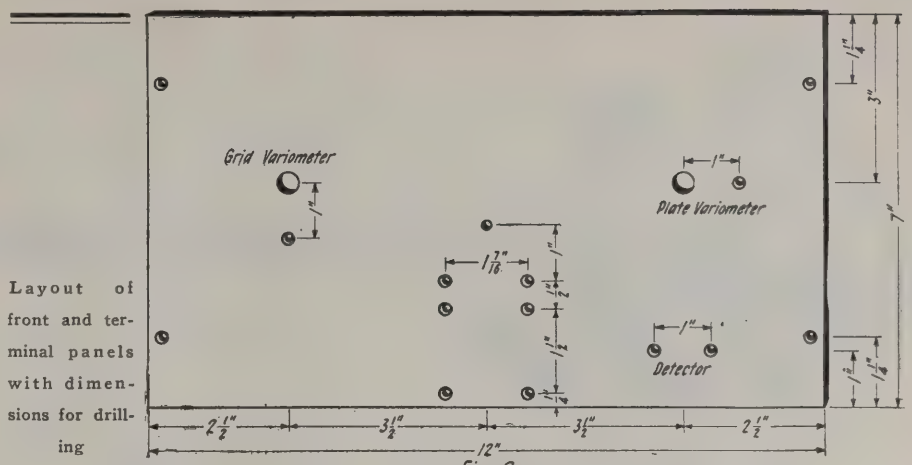


Fig. 2

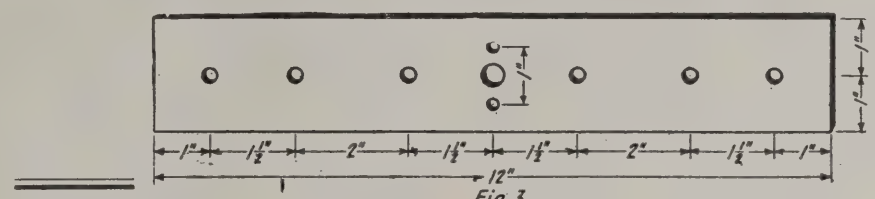


Fig. 3

Material

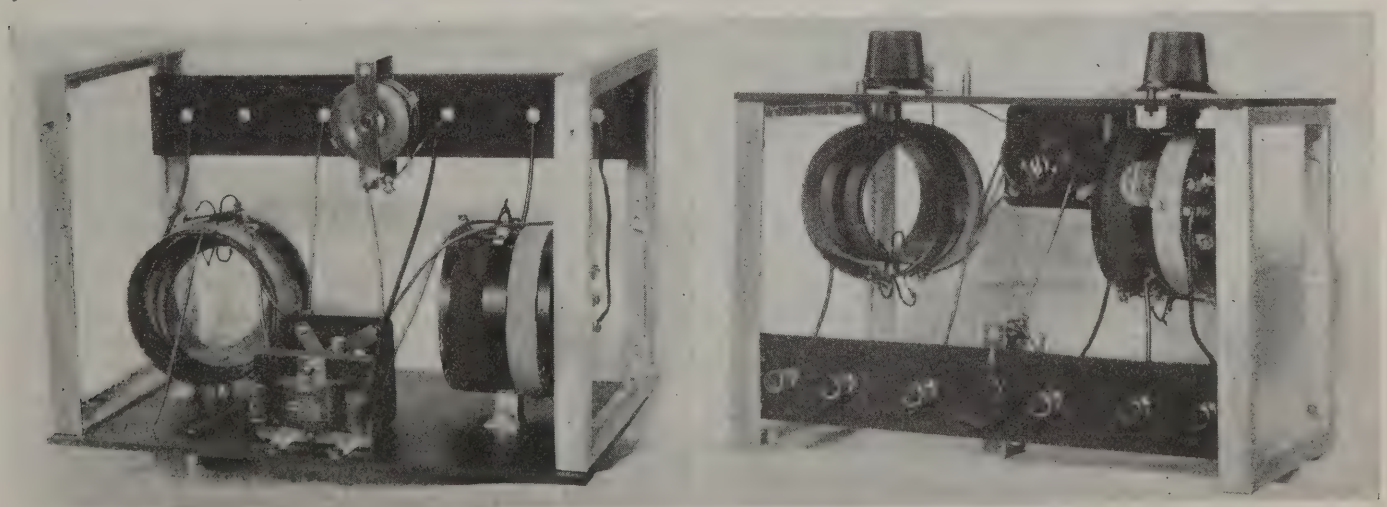
Although the trade names of the parts used in this set are quoted here, one should feel perfectly free to select other makes; especially if it is definitely known that such makes are of good quality.

Two variometers; those shown (Shamrock) are mechanically a trifle weak and the wavelength variation is not as great as can be secured with variometers of the "cup and ball" type in which the windings are close together.

Two 180° dials to fit the shafts of the variometers. (Sleeper.)

One audio frequency amplifying transformer. (General Radio.) This should be of low ratio for no other reason than the reproduction is better. The new Radio Corporation UV-712 (low ratio) will prove satisfactory.

(*Continued on page 72*)



Top and bottom views of the assembled reflex receiver

Workshop & Laboratory

A Regenerative Receiver

Made With the Parts Used in "A Crystal Receiver" Described in "The Wireless Age" for January

Cost: About $20 Range: From 100 to 1,000 miles

BY adding a dry cell vacuum tube to the crystal receiver described in the January WIRELESS AGE the range of reception may be considerably increased and even though the apparatus appears crude it is possible to obtain splendid results through careful handling of the sliders; this combination of single circuit and regeneration makes for good volume and excellent sensitivity.

The material should be gathered together and then carefully arranged on a board with the parts placed in much the same position as they appear in the sketch. It will then be a very simple matter to follow out the circuit in making connections.

In wiring use No. 18 hard drawn copper wire insulated with cambric tubing—or "spaghetti"—as it is more usually termed. Make the filament circuit first. This consists of the rheostat, the two binding posts to which the dry cell is connected and the two terminals marked "F" on the tube socket.

Make the connections exactly as shown and either clamp the wire in the terminals or better still, solder the joints.

Do the plate circuit next. Starting from the terminal marked "P" on the tube socket bring a wire to the first binding post. Connect the two center binding posts together and wire the fourth binding post to one of the slider rods. Connect a ('phone) condenser across the first and fourth binding posts. Connect the other slider rod to the positive dry cell binding post and connect this same post to the ground binding post.

The only remaining part is the antenna-grid circuit. Connect the antenna binding post to one side of the fixed antenna condenser. Connect the other side of this condenser to the beginning of the wire on the tuning coil and also to one side of the grid condenser. The other side of the grid condenser is connected to the terminal marked "G" on the tube socket.

Finally, the grid leak mounting is connected across the grid condenser.

Now place the vacuum tube in the socket. It will be found that a short pin in the tube base just fits into a slot in the socket shell. Make certain that the socket springs are bent upward so they press firmly upon the four small pins set in the porcelain base of the WD-12 tube.

To receive, having connected the antenna and ground, turn the rheostat knob in a clockwise direction till the filament of the tube glows dull red. Move the plate (p) slider to the lower end of the inductance and slowly move the ground (g) slider along the rod until the carrier wave of a transmitter is picked up; leave the slider there and promptly move the (p) slider toward the position of the (g) slider; a point will be found at which the whistling ceases and the "broadcasting" may be heard. Again vary the (g) slider a turn or so for best results.

Then adjust the rheostat to a point where the filament is as dull as possible consistent with good signal strength.

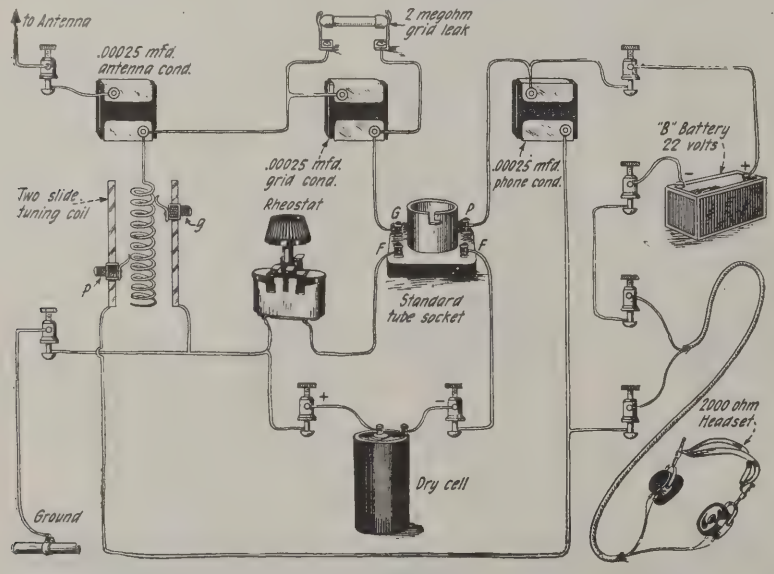
After a time one should become adept at picking up stations without allowing the receiver to oscillate as it is when the "carrier wave" can be heard.

MATERIAL

1—Two-slide tuning coil.
3—.00025 mfd. fixed condensers.
1—Standard tube socket.
1—Rheostat
1—Two-megohm grid leak and mounting.
8—Binding posts.

ACCESSORIES

1—WD-12 vacuum tube.
1—Pair 2,000-ohm 'phones (headset).
1—Plate "B" battery, 22.5 volts.
1—Filament "A" battery, 1.5 volts (dry cell).



Pictorial hook-up of the regenerative receiver

"Why I Became a Radio Fan"

(*Continued from page 18*)

Brighton, of Norwood, Pa., who got her first thrill from WOO over a home-made crystal set. She concludes her letter with the significant words:

> "To any one confined in the home radio is a godsend. I think it helps one to cope with everyday problems better and also gives music-lovers a great treat."

Dr. Sidney L. Rubens, of Chicago, won the Fifth Prize by telling how radio assisted him in his dental work.

Space cannot be devoted here to citing all the various incidents and accidents that have brought our readers into the field of fans. They include the determination not to be stumped by a strange, queer-looking diagram and an unfamiliar branch of technical experiment, as well as the yearning to solace and brighten the hours of a loved invalid. Some of the best of our replies could not be considered for this contest because they far exceeded the number of words allowed. One of them came from a business man who felt the need for a hobby that would give him diversion and at the same time the companionship of his family, especially the boys. One most appealing response came from a "shut-in" in Providence, R. I. "Without radio my world was within the four walls of my room," he writes; "now Aladdin and his Lamp have nothing on me and my Radio." Others speak of the thrill of getting distant stations and of getting louder and clearer reception of the programs of local broadcasters.

Felix and His Family Fones

And now, to bring this survey of Radio Fans to a fitting close, you are herewith introduced to Felix and his family. Here, it is believed, is exemplified to a notable degree one of the greatest of the virtues of radio: its perfect adaptability to the home, and its tendency, in this day of many outside distractions and attractions, to perpetuate and strengthen our home and family life.

Felix Cadou is manager of the Liberal Light, Ice & Power Co., Liberal, Kans., and is a radio fan who believes in headphones and in the entire family sharing them. So he designed and constructed a special stand to hold the four pairs of phones that are used when he and mother and brother and sister listen in at the same time, as they frequently do. The stand is connected with the receiving set by means of a long flexible cable, so that it can be moved anywhere in the room. In its base is a switch that governs the phone circuit, so that one, two, three or all four headsets may be connected or disconnected, as desired. "Felix" means "happy," and comes from the same Latin word that "felicitations" does, and so when friends felicitate Mr. Cadou on his ingenuity and skill in arranging this stand, their appreciations are doubly earned. He thinks that a loop antenna is to be preferred in selecting one among several conflicting broadcasters, and likes the headphone because it brings to the ears all the delicacy of the fine tones that are broadcast. "We think we get best results with a loop, headphones, and my stand that takes all the inconvenience out of having the receivers on your ears," he says.

IWAJ Broadcasting

(*Continued from page 29*)

"I confess I am getting a little flustered," Harmstrong put in, edging forward.

"They have agreed to the proposition which I have advanced," Russell announced. "And they thought that you would, too."

"What are you going to do, get jobs from all of us?"

"No, sir, but a job from all of you."

"And they engaged you?"

"They did."

"And said I would, too?"

"Yes, Mr. Harmstrong."

"Hum. Well, what's this job of yours?"

By this time the banker was betraying a high degree of interest. His secretary entered the room and was signaled not to interrupt.

"This is the situation in a nutshell, sir," Russell asserted earnestly. "I do not want a job—in the accepted sense of the term. *What I want is—your backing for my hospital for children.*"

Harmstrong was silent.

"You see, Mr. Harmstrong," Russell continued, "I am a doctor, and I have specialized in children's diseases ever since the first year of my six years' practice of medicine. Need I tell you, I have seen the pressing need of another modern institution to relieve present overcrowded conditions in New York, for the treatment of afflicted children, under proper conditions, rich and poor alike. I know you have given thousands of dollars for hospitals, in one way or another. But I feel this is a vital situation in which you and a few other men can offer the solution. I have some means; Sydney Russell was my father. But I could hardly undertake such a project. That's why I want this to be a special contribution, not alone of your means, but of yourself, your continued interest and active support. Will you help to make me director of this new hospital. The Hospital for Children—your hospital?"

The banker hesitated a moment.

"Why didn't you write me about this?" he asked.

"Because I wanted to present the case as strongly as I could. Then again, because you undoubtedly receive a bunch of letters every day, asking for donations, for one cause or another. You must, in your position. You cannot read them all; you can only heed a few. You could hardly be expected to do more."

"No, my secretary attends to them, ordinarily. There are, of course, some things which I handle personally."

"Just that—and that is why I have taken this method of enlisting your interest and support. This hospital—this radio hospital—is wanted right now. And it will take a year to establish."

"Just a minute."

Harmstrong sprang up and walked quickly into another room. Howard smiled at the doctor, and the visitor smiled in turn.

"I bet he's phoning 'em," the secretary remarked.

In a few moments Harmstrong returned, put his hand on Dr. Russell's shoulder, and said heartily:

"Russell, I have talked with Gayne and Dodgworth, and we have come to an agreement. We will back you, 33⅓ per cent. each. I have the pleasure and honor of designating you, on my part as theirs, director of the Hospital for Children.

"Go right ahead, doctor. Get your plans ready. We will put them through. And speaking about children, seems to me I. W. A. J. stands for 'I wish all joy.'"

The happy young physician responded:

"I hadn't thought about that, but it's just what all this means."

* * *

Two weeks later Dr. Donald Russell, looking over a heap of letters which had been addressed to him in care of WFFA, laughed as he tossed one of them to his smiling wife.

"This is from Hurleyville, Pa.," he said.

She read: "Hope you landed that job all right. I had a tough time myself. Couldn't get situated in the city, tried everything but the radio, but no use. So I have taken to farming—and it is all right, with the wireless, etc. I know how you feel. If you got kids dependent upon you—"

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Founded to promote the best interest of radio communication among wireless amateurs in America

Guglielmo Marconi, *President* HEADQUARTERS: 326 BROADWAY, NEW YORK H. L. Welker, *Secretary*

Prof. Alfred N. Goldsmith, *College of the City of New York* E. E. Bucher, *Instructing Engineer*

The Trans-Atlantic Amateur Tests

Reported Reception of English, French and Dutch Stations by American Fans Overwhelm Officials

THE American amateur now burns the DX oil through the wee hours listening-in for the distant call letters of foreign fellow fans equally eager to join in the universal game of radio.

American amateurs were urged to listen for signals from amateur stations in Continental Europe during the period of December 22, 1923, to January 10, 1924. It was the fourth series of trans-oceanic tests under the auspices of the American Radio Relay League in an effort to promote better amateur communication between America and Europe.

To facilitate receiving at this end the French and British amateurs transmitted on alternate nights, during the hours from 8:00 P. M. to 1:00 A. M., Eastern Standard Time. It was primarily essential that our fans should not "break in" during the twenty days of testing as every support had to be lent toward the establishment of two-way trans-Atlantic amateur communication. Since the efficiency of our amateur transmitters was adequately proved last winter during the third series of tests there was little danger at the outset that there would be any interference on this side.

But by way of special inducement to insure "quiet air" during the tests, $3,500 worth of prizes were offered for the best reception reports turned into the American Radio Relay League's Headquarters.

And by way of response the American amateurs have literally swamped Mr. Schnell with their reports.

Between breaths Mr. Schnell gasped, "The tests have snowed me under completely and I can see no daylight for several weeks."

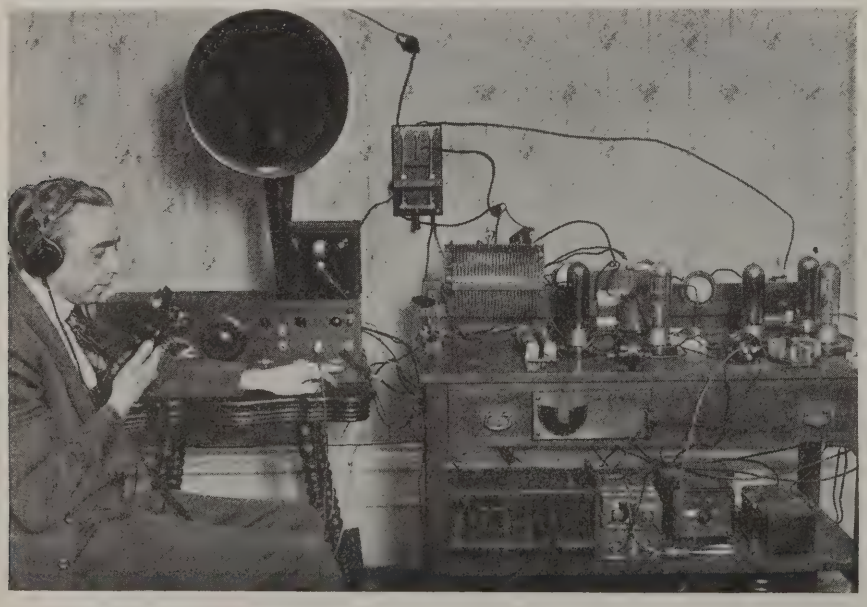
So, nothing for it but to print the full report of the tests in an early issue.

Some of the early reports list the following stations heard by American amateurs:

British stations heard—2NM, 2FQ, 2KF, 2SZ, 2OD, 2KW, 2FN, 2IN, 2SH, 5AT, 5LC, 5PU, 5BV, 5KO, 6NI, 6XX, 6YA.

French stations heard—8AB, 8AE, 8BE, 8BF, 8CT, 8LY, 8ARA, 8AZ, 8BM, 8CD, 8CS, 8JL.

Dutch stations heard—PA9, PC11, PA-0DV, PAR14.



Mr. Kenneth Decker's amateur radio station, 2CMK, a 250-watt transmitter, has been heard in every district of this country as well as Honolulu and Cuba, but he blew out no less than 17 fifty-watt tubes before he had his station working efficiently

San Diego Radio Club

By Dr. A. E. Banks
6XN, 6ZB

SAN DIEGO fans on the 2nd of November 1923, completed the organization of what promises to be an enthusiastic, progressive and useful radio club. The nominal membership approximates six thousand, and is made up of all those individuals residing in the County of San Diego who are licensed operators, broadcast listeners, owners of broadcast stations or anyone interested directly in radio.

The San Diego Radio Club has in its first president, Judge Eugene Daney, all that could be desired as an executive head.

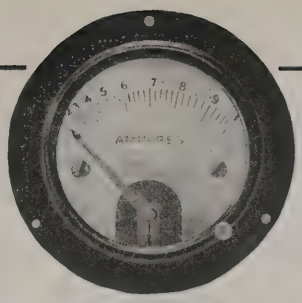
The old amateur organization, Sunset Radio Club, has joined hands with the broadcast listeners and others, in the making of the new club. It is the theory of the San Diego amateur and broadcast listener that the use of the ether for any specific purpose must be a matter which is interesting to all classes of operators alike. With co-operative support well developed, the mother organization will take care of all subdivisions of activity. According to the plans of President Daney the business sessions of the club will be more or less infrequent, perhaps once a quarter, at which time matters will be brought up which interest the membership as a whole. On the other hand sectional programs are to be arranged which specifically apply to the various types of membership. That is to say the amateur may have his technical meetings, the broadcast listener another type of program, the broadcast station owners their special sessions.

San Diego, while ideal for almost everything, has been one of the worst places for radio reception. Being a port city and having powerful Naval radio stations both arc and spark located in its midst, continued interference from improperly installed, poorly maintained and operated apparatus has been the rule. Efforts to obtain relief is where the San Diego Radio Club will find its mission.

One of Mr. Daney's first announcements upon assuming the chair was to the effect that he sincerely hoped that the club would manage in some way to rid the ether of useless interference.

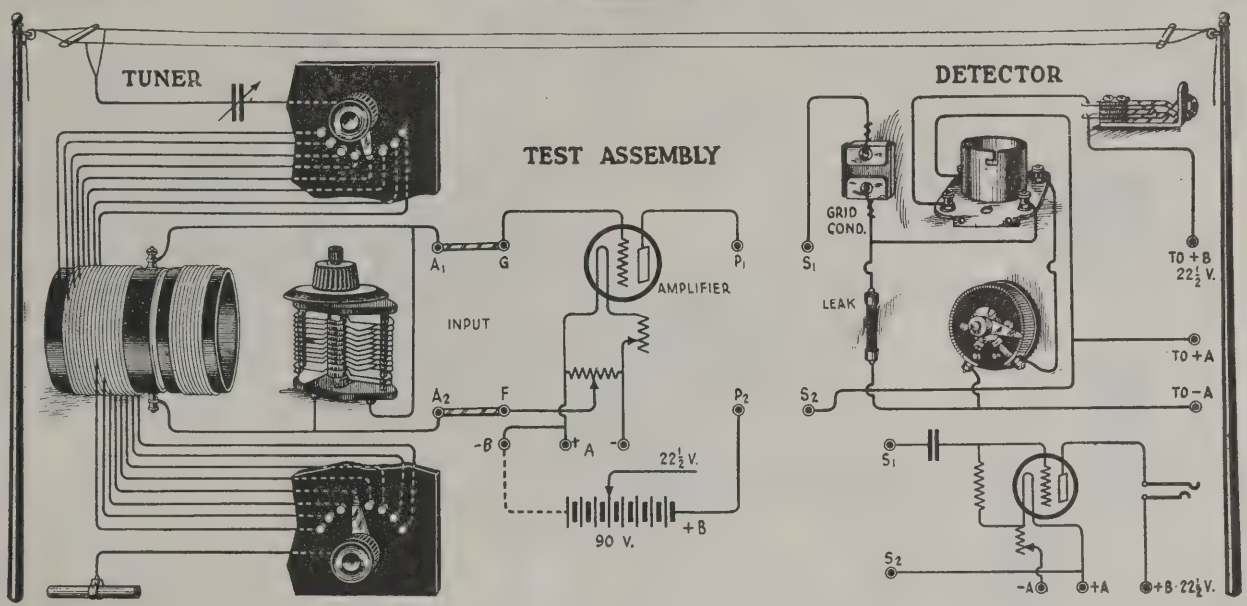
THE TEST TABLE

A REGULAR MONTHLY DEPARTMENT OF AUTHORITATIVE INFORMATION ABOUT RADIO APPARATUS



COPYRIGHT 1924

BY
R. P. CLARKSON
AUTHOR
RADIO DATA SHEETS



RADIO FREQUENCY

At the right we have a detector tube circuit. Its output goes to our phones. The input terminals (grid and filament) require as great an amplitude of oscillating voltage variation applied to them as possible so that the plate current fluctuations which affect our receivers will be large, especially on weak signals. We may connect detector input terminals S_1 and S_2 direct to the tuner output terminals A_1 and A_2 and rectify the received signal, but weak signals might be lost by doing this. One alternative is to increase the signal strength before attempting to listen in. This is the purpose of R.F. amplification.

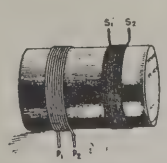


Figure 1—R.F. transformer

We may take the test assembly of last month and to the tube input (always grid and filament) connect the output terminals A_1 and A_2 of any form of tuner. Using a hard tube the weak signals impressed on its grid will be amplified, there will be none of the rectifying losses, and if plate output terminals P_1 and P_2 are connected together to complete the circuit, there will be plate current flow which fluctuates with greater amplitude than the voltage fluctuations at the tuner output terminals.

Now we have the problem of affecting the detector with this plate current flow. We can't just break the circuit at P_1 and P_2 and connect in the detector tube. That would take the positive potential off the plate, would interrupt the current flow and short circuit the B battery. It would not apply amplified voltage variations to the detector grid. The obvious thing is to couple the two circuits together with two coils. If the coupling is fixed it is the ordinary form of R.F. transformer. The primary is connected to P_1 and P_2 and the secondary to S_1 and S_2. Because the coils are of fixed inductance and capacity, some particular wave length will pass through much more easily than others.

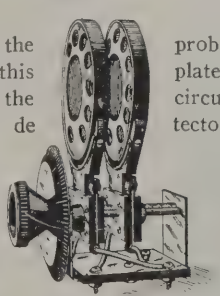


Figure 2—Variable coupler

We might use two honeycomb coils in place of the transformer windings. Varying the coupling between them would help selectivity, but decreasing the coupling would decrease the signal strength. To tune the circuits and still pass on all the signal strength, the natural device is the same as used in a single circuit receiver. Put in a variometer between P_1 and P_2 or some other form of inductance shunted with a condenser for tuning, and connect S_1 to P_1. Do not connect S_2 to P_2 as they are already connected through the filament battery. This arrangement is called tuned impedance.

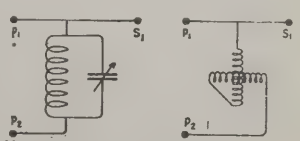


Figure 3—Tuned impedance

We might substitute a high fixed resistance—about 70,000 ohms—in place of the tuned impedance. What we want is to have the fluctuating current which normally passes between P_1 and P_2 go through some opposition—resistance, inductance or capacity or any combination of them. Then there will be a difference in voltage between these two points, varying as the plate current varies. This amplified voltage we pass on to the detector.

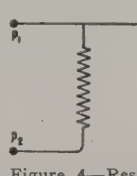


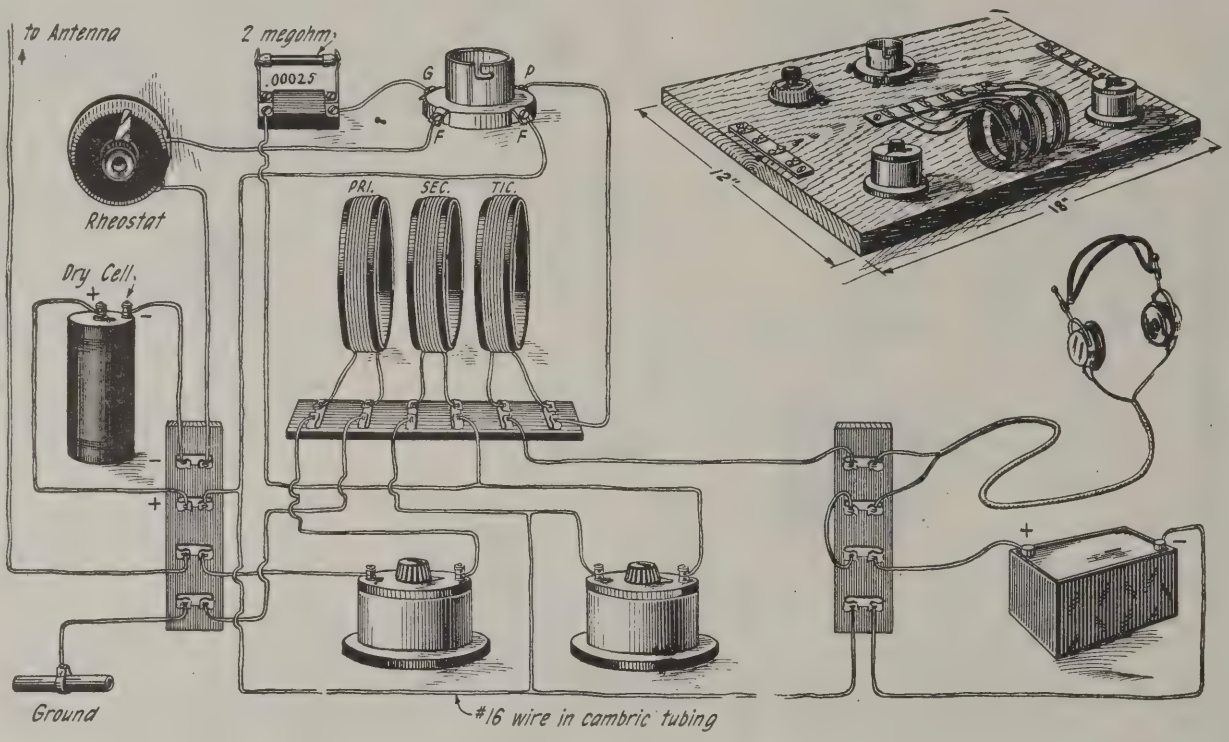
Figure 4—Resistance coupling

We might well combine tuned impedance and resistance coupling by winding our variometer with resistance wire. This will stabilize our circuits.

RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher



THE HOME LABORATORY OUTFIT WILL COST ONLY FROM $20.00 TO $30.00 COMPLETE

MANY an amateur enthusiast would like to know all that a radio engineer is supposed to know; he would like to be independent of the opinion of "experts"; he would like to be able to say what is good and what isn't good in radio design. More—he would like to be able to design apparatus and complete instruments himself—without having to guess about a single thing.

But he finds it difficult to learn radio through a study of text books alone for they are either too elementary or so full of detail that one must be an engineer to understand them; equally difficult does he find experimental work, for the power of his observation is limited by the extent of his knowledge.

In truth, there is only one way to learn radio; and that is to dig into it in a systematic and wholehearted manner; combining text book reading with actual experimental work. For without one the other is almost useless while both combined makes the study of "Radio Engineering" an easy, enjoyable and often profitable pastime.

Such a course is to be given in THE WIRELESS AGE. Here in this column from month to month we will indicate the line of basic experiments to be followed and we will suggest to the student what text books are to be read. The experimental equipment and books will cost but little; the former can be used in regular receivers at any time; the latter are always handy for reference.

The material required for this home-laboratory course consists of the following:

Two .0005 mfd. (23-plate) variable condensers, enclosed for table mounting. If any "panel" type are on hand they may be mounted in neat, shellacked boxes made from cigar box wood; or they may be mounted under the test board with only the knob and two Fahnestock terminals on top. Secure a good make of variable condenser, as they may be used over and over.

Three coils each wound on a thin rubber or shellacked cardboard form 3 inches diameter and 1 inch long with 50 turns of No. 28 or 30 double cotton covered wire; use small Fahnestock clips on each form for connections. Dry the coils in a warm oven and apply a light coat of collodion (one ounce—at any drug store) to the windings.

One standard tube socket, preferably porcelain; replace the four binding posts with large Fahnestock clips.

One table mounting rheostat of 6 or 30 ohms.

One .00025 grid condenser and a grid leak.

Three terminal strips of hard rubber 1 x 6 inches equipped with double Fahnestock clips as shown.

One sandpapered and shellacked wood base of the size indicated.

Arrange the apparatus as shown in the sketch, screwing the material to the base with brass wood screws and wire in exact accordance with the pictorial diagram—keep the connections close to the base.

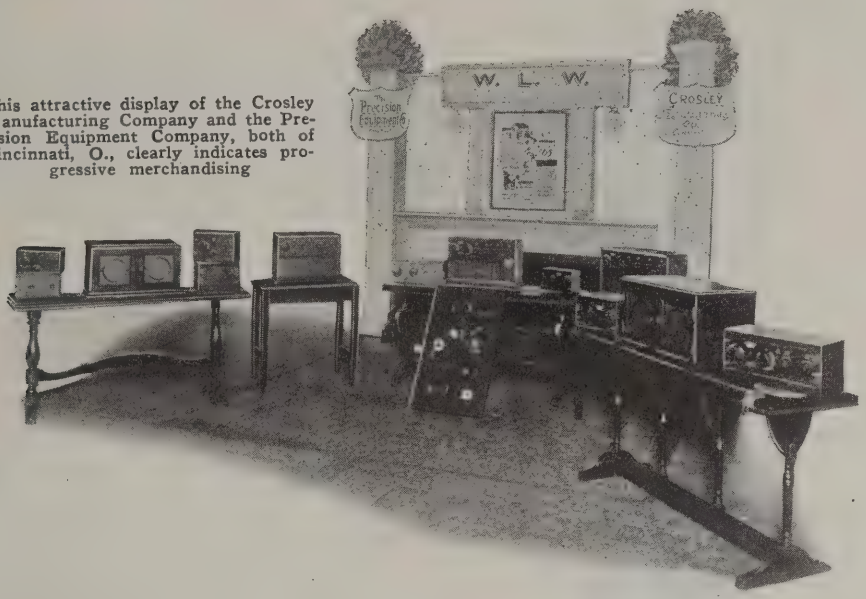
Any vacuum tube may be used, but if none is on hand we suggest the purchase of a UV-199 (C-299) and adaptor. In this case the filament battery should be of 3 cells instead of one and the rheostat must be of 30 ohms.

No operating instructions or experiments will be given this month, but the student should become familiar with the assembly and learn the correct method of tuning by himself. Next month he may see how his ideas check up with Radio Engineering.

As for text books—the first to be secured is E. E. Bucher's "Wireless Experimenter's Manual," which may be secured from the Wireless Press, Inc.

(*To be continued*)

INDUSTRIAL INKLINGS



This attractive display of the Crosley Manufacturing Company and the Precision Equipment Company, both of Cincinnati, O., clearly indicates progressive merchandising

J. L. LEWIS, a New York retailer, held a radio show at his store, 132 W. 32nd Street, which lasted one week in celebration of the 25th anniversary in business, of which radio has lately been a large part, and to emphasize the fact that the firm is going into wireless stronger than ever. Two window displays devoted to radio were changed frequently and radio displays were arranged in the store by several prominent manufacturers.

HARRY C. GAWLER, for the past three years connected with the sales department of the Radio Corporation of America, is now Sales Promotion Manager of the General Radio Company, Cambridge, Mass.

THE Multiple Electric Products Company, Newark, N. J., has prepared an original display card to set off their Atlas Amplitone Loud Speaker. The well-known picture of a beautiful girl singing out of the horn has been executed on a not too large display card which dealers may secure upon request. Another mark of their enterprising methods is contained in a rather costly booklet, "Marketing and Distribution of Radio."

HERMAN ROSE, president of the Shamrock Manufacturing Company, entertained one hundred and fifty retailers in the Newark territory. Mr. Mortimer Salzman and Mr. Sparer of the Wholesale Radio Equipment Company of Newark, were prominent in aiding Mr. Rose in conducting the affair. The theater party and banquet were so successful the guests had to ride home with the milkmen.

THE United States Post Office has warned advertisers against the common practice of omitting their street address in their advertising. Postal employees cannot memorize all the locations of even the largest concerns and as a result some 80,000 pieces of mail are received daily at New York that must be delayed in its distribution to points of delivery. Quite often, non-delivery is the result of street address omission.

THE "RADIO LIMITED," a cyclonic trade crusade through the Great West —Pacific Coast and return—was under the personal direction of James F. Kerr, 127 N. Dearborn Street, Chicago, having been organized to boost the radio interests through the Middle West. This train, carrying 125 passengers, left Chicago January 27th, arriving in Los Angeles ahead of the opening of the Biltmore Hotel Radio Show, conducted by the American Radio Exposition. On the way out stops were made at Omaha, Denver, Salt Lake and Los Angeles, and on the return trip, San Francisco, Portland, Seattle, Spokane, Butte and Minneapolis. Publicity agents preceded the excursion to round up the dealers and jobbers, to "place" billing and advertising and to consummate all arrangements for the reception of "The Radio Limited."

THE Diamond State Fibre Company, Bridgeport, Pa., has prepared a catalogue that presents "Condensite Celoron" products in a thoroughgoing manner. Condensite and Celoron are described and the various uses for the product are discussed at length, elaborating on the grades and tests. A commendable fact about the booklet is that it has been made up in a clear and altogether interesting fashion.

THE Central Radio Laboratories of Milwaukee, Wis., have been advised that their CRL Non-inductive Potentiometers and CRL Grid Leaks, have been selected and approved by the engineers of the National Radio Engineering Company and the report forwarded to the Association of Railway Electrical Engineers.

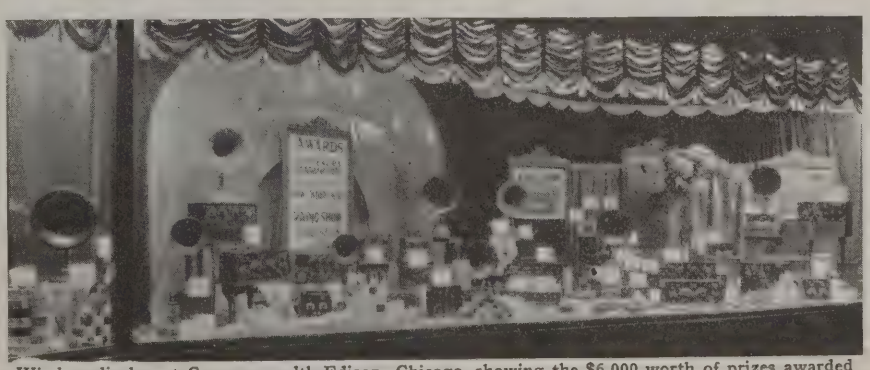
HENRY L. SEIDMAN, Chairman of the Radio Trade Association Cost Finding Committee, has solved one of the "troubles with the world" in his analysis of the inventory evil. He tells how to keep an automatic inventory by a simple system of cards. A separate card for each item, ruled and filled out with data of date purchased, quantity purchased, from whom purchased, cost each and the amount all to be totalled yearly, will enable the dealer to keep perpetual check on the stock by items and the individual costs. The system is unique in its simplicity and ease of keeping up-to-date.

THE name "Mahoganite" is owned exclusively by the American Hard Rubber Company, and they alone have exclusive right to its use on materials and parts. Other manufacturers using the name "Mahoganite" on any of their products are guilty of infringement.

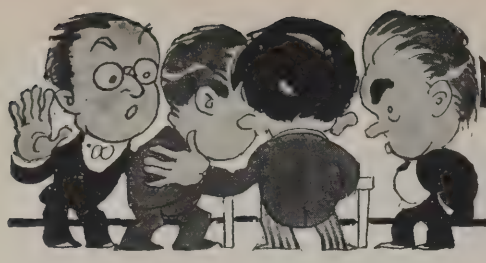
THE Smith Radio Manufacturing Company of Washington, D. C., will go into production of the SMITHTONE Radio Receiving Sets.

The Smithtone will be produced in five models with a capacity of fifty sets a day.

Howard Carter who for many years was associated with the automobile industry from its pioneering days will be the production manager.



Window display at Commonwealth-Edison, Chicago, showing the $6,000 worth of prizes awarded in the listeners' program vote held by stations WJAZ, KYW, and WDAP. Of the 600 articles, 30 were complete sets. Incidentally, the drawing for these prizes was one of the events that made the Chicago Radio Show "go over" big



NEW APPLIANCES AND DEVICES

Bel-Canto Loud Speaker

THE new model of the Bel-Canto Loud Speaker shows several changes in design. It is now equipped with a fibre horn and the base has been re-designed adding materially to its attractive appearance.

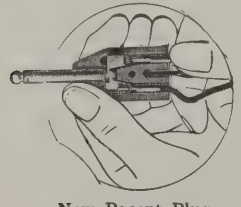
Co-incident with the introduction of the new model, the Bel-Canto Manufacturing

Bel-Canto Loud Speaker

Company have adopted a new sales policy and are offering their loud speaker direct to the user at a material reduction in price.

New Pacent Plug

TO the end of meeting the demand for an inexpensive yet practical plug, the Pacent Electric Company engineers have developed the improved "Forty" Universal Plug, which is shown in the accompanying illustrations. Here is a plug that is immediately attached to the usual telephone cord tips in the manner shown, with a per-



New Pacent Plug

nament bull-dog grip of entirely new design. The pushing of the cord tips into place by the mere assembling of the plug shell locks the grip of the connection clips, while taking the shell apart unlocks the grip and releases the cord tips. The new Pacent plug is neat, small, and convenient for use anywhere. The metal parts have a heavy nickel satin finish. Its conducting parts insure perfect contact and conduction of weak radio currents, while its molded insulation insures against the leakage of currents. No live parts are exposed. The gripping members have polarity data stamped on them. Finally, the ingenious design and simplified construction, together with a large output, has served to bring down the cost of this plug to a modest price which now makes it feasible to use many plugs for radio reception and experimentation.

Simplified Grid Control

THE Randel Wireless Co., Newark, N. J., has brought out a combination variable condenser and variable grid leak called "The Grewol Vari-Grid." The claim is made that it entirely displaces all 11 and 23-plate condensers and the old type grid leaks with an attractive appearing, all-enclosed, compact instrument that takes up but 1¾-inch of space on the panel. The Grewol Vari-

Simplified Grid Control

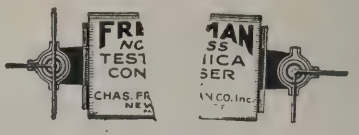
Grid can be used separately either as a variable condenser or as a variable grid leak. The makers claim considerable improvement in distance and clarity by using this instrument, and recommend its use in the aerial and secondary circuit as well as in the grid circuit. Only one hole is required for mounting.

Freshman Condenser

WITH an evident realization of the importance to clear-toned radio reception, of affording the best possible soldered connections in fixed condensers, the Chas. Freshman Co. of New York City, have made a radical improvement in the design of all capacities of their tested noiseless mica condensers, which should prove a boon to manufacturers and radio enthusiasts who build and tinker with their own outfits.

A lug of special construction is riveted by means of an eyelet to each terminal of the mica condenser. The lug is equipped with three grooves, permitting the wires to be laid properly, and held in place while being soldered.

Another most important advantage is that in wiring a set the connection can be made temporary without soldering. In this way the circuit can be tested and varied so as



Freshman Condenser

to give the most efficient results. When this is attained the connections are soldered.

New "B" Battery

A NEW type of "B" battery constructed so that most of its bulk is raised vertically instead of occupying valuable horizontal space, is now available to radio fans whose table area is limited. The new battery is No. 764 of the National Carbon Company. It gives 22½ volts, and is only 3⅛ inches wide. Its height is 5⅝ inches.

The new battery has twice the life of the small portable "B" battery, while standing on practically the same size base, and the cost is only about one-fourth more than the cost of the small one. It was developed after months of experimentation by engi-

New Eveready "B" Battery

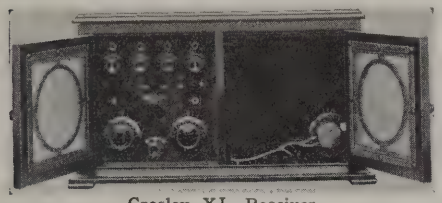
neers of the National Carbon Company, who knew that many radio users were increasing their battery operating cost in order to economize on space or to save in first cost. The new battery gives much lower operating cost without appreciable sacrifice in table space.

The Crosley XL Receiver

THE growing popularity of the furniture idea is upon us, and to meet this growing demand comes the Crosley Model XL, a beautiful piece of furniture incorporating the radio panel behind the left hand door, and the loud speaker and amplifying sound

chamber behind the right hand door. In the rear of the cabinet, easily accessible by raising the hinged lid, is ample room for six or eight dry cells to supply the filament current, and a shelf for the necessary "B" batteries.

One stage of tuned impedance-coupled radio frequency amplification, a vacuum tube detector and two stages of audio frequency



Crosley XL Receiver

amplification are used to provide long distance, loud speaker reception. The inductances are in the form of a staggered spider web; condensers are of the "book" type. Only two tuning controls are employed.

The "Aristocrat" Radio Headset

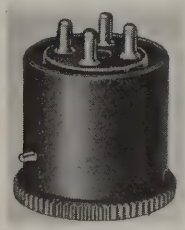
THE "Aristocrat" Model Radio Headset has just been placed on the market by the Dictograph Products Corporation, New York.

This headset is a decided improvement over the previous designs. The ear caps are of hard rubber finished in black streaked with orange. They are made extra large to insure comfort while wearing. The head band and cords are finished to match the caps. The phones are exceedingly light in weight, and can be worn for hours without fatigue. In both distance work and volume this headset excels. Like a watch, it is a sensitive, finely constructed precision instrument, made to give service for years.

Dictograph radio headset magnets are made of the two pole, or bipolar type, each pole being wound with 4,500 turns of No. 44 B. & S. gauge enameled copper wire, having a resistance of 750 ohms each, all being connected in series, giving a total resistance of 3,000 ohms per headset. The minuteness of this wire can be realized from the fact that 500 of these could be laid side by side within the space of an inch.

New Eisemann Adapter

THE Eisemann Resistance Adapter has been developed to provide a method for utilizing either UV-199 or C-299 Radiotrons



New Eisemann Adapter

in a radio receiving set equipped with standard base sockets and low resistance rheostats.

If the rheostats in the receiver are of low resistance the A battery should have a value of 4.5 volts.

The change may be made by connecting to a filament battery of proper voltage and inserting the resistance adapter.

Jefferson R. F. Transformer

JEFFERSON Radio Frequency Transformers will function with equally efficient amplification over the entire new wavelength band (200 to 650 meters) in standard radio frequency, reflex, inverse, duplex or neutrodyne circuits.

Jefferson R. F. Transformer

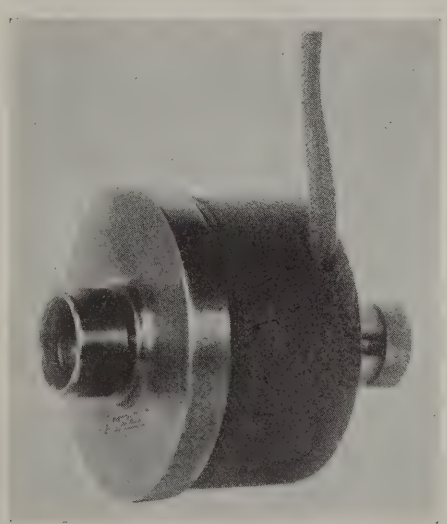
It is necessary in any radio frequency amplifier to keep the capacity coupling between coils as low as possible and yet maintain good inductive coupling. This has been done with the Jefferson transformer by making the primary and secondary coils in the form of distributed windings. The silicon laminations take care of the required inductive coupling; at the same time shielding the winding from any external capacity that might be detrimental to tuning.

The transformers are assembled in handsome black enameled steel cases. The nickel-plated binding post terminals are set in bakelite bushings and are brought out at a convenient angle near the top of the case.

Accuratune Phonograph Unit

THIS is a new item in the line of the Mydar Radio Company.

Designed to harmonize with the instruments with which it will be used, its rugged construction and adjustable air gap insures the satisfaction given by other Mydar products.



Mydar Phonograph Unit

The unit is equipped with flexible cord with terminals marked to indicate polarity.

The heavy shell and cork inserts prevent chattering and vibration. No extra battery required for operation. Finish—black with lacquered brass trimmings.

Broadcasting in the British Isles

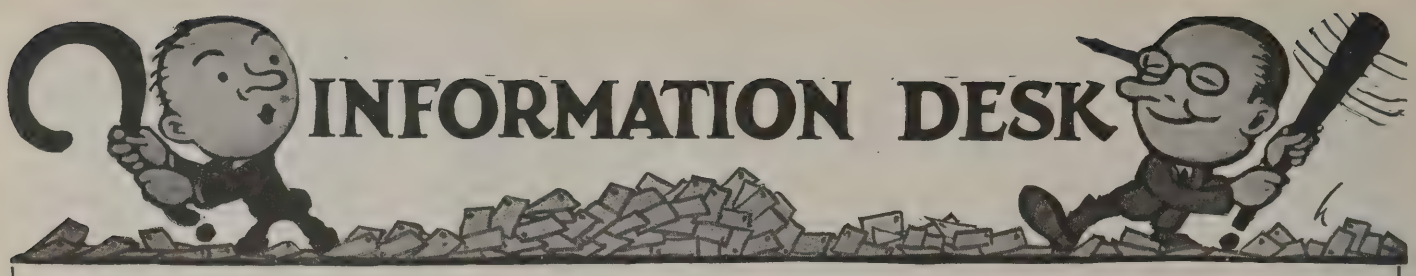
(*Continued from page* 41)

We were also faced at one time with threats from the concert organizers which looked like making things very difficult for us. There are certain concert platforms in London which are a sort of Mecca for young artists, and artists look forward to appearances on these platforms as essential stepping stones in their careers. The director of the principal series of concerts issued a letter pointing out that artists singing at our stations would not be allowed to sing in his programs, and this line of action was also taken by another group responsible especially for Sunday evening concerts, of which there are a great number. Fortunately the British spirit of freedom again asserted itself and a group of leading British artists refused to be intrigued. These have been given useful contracts and are touring all stations providing the high-water mark of musical performance. Their action has had a steadying effect amongst younger artists and we are confident that our obstructionists will learn ere long how unwisely they have acted.

Our relations with the several gramophone companies are cordial and our correspondence from listeners indicates unmistakably that broadcasting is giving material assistance to the publishers and retailers of music and records.

Personally I believe that broadcasting can strengthen old and create new tastes and that the organizations now endeavoring to hinder broadcasting are wasting in a futile manner energy which if applied to co-operation with the broadcaster might considerably assist them in the difficult times. If we, by sheer necessity, are forced to produce our own plays, then there is just the risk that listeners will stay at home who otherwise would have visited the theaters. In this case the boycott more than defeats its own object.

We, who are responsible for the development of broadcasting in England, are alive to the fact that we are working with a medium having positively astounding possibilities. We realize our responsibilities and would welcome a regular exchange of views with those engaged in an even more extensive manner with the same developments in other countries, particularly in the mother country of the movement—the United States of America. Our only regret is that owing to time differences which cause practically all British transmissions to take place in your hours of daylight, it is not possible to listen to our performances and form first-hand judgment on our activities.



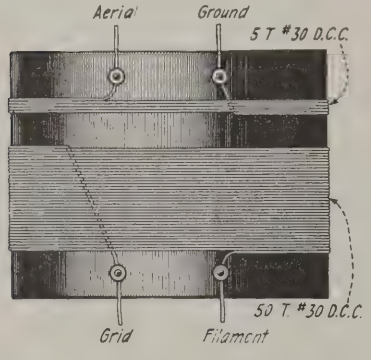
CONDUCTED BY JOHN R. MEAGHER

A self-addressed stamped envelope will insure a prompt reply to any queries on radio

More About the Uni-Control Receiver

OF all the inquiries about the uni-control described in THE WIRELESS AGE of December, 1923, most have been concerned with the probable cost; where the parts may be purchased and what disadvantages are to be expected.

Starting with the last mentioned subject it might be of interest to know that the other evening we had the uni-control at home (in New York) for the purpose of hearing Major Howe, the editor, speak from WJY. A loop was not available so we used a single No. 18 wire about 80 feet in total length erected only a few feet above the roof. A small fixed coupler, similar to that shown in the sketch, was used with this improvised antenna. The receiver worked very well and after enjoying Major Howe's talk we "fished" around for "DX" stations, the best of which was WDAP, Chicago, Ill., received with such volume that actually it was necessary to shout to make oneself heard in the room! And as for distance, KFKX, Hastings, Neb., rolled in with a comfortable intensity: and when he signed off, KOP, the excellent and albeit appropriately called police station in Detroit came in.



The only evident disadvantage was distortion on the third stage. However, this was considerably reduced by connecting a variable resistance across the secondary of the third audio frequency amplifying transformer or by connecting it between the grids of the second and third audio frequency amplifying tubes. The resistance should have a minimum value of 50,000 ohms and a maximum of a half megohm (500,000 ohms) or more. I believe there are some variable "grid leaks" that have a minimum value between 50 and 100,000 ohms; they will be satisfactory.

It was found advisable to ground the filament (either terminal) and to change the tubes around for best results. A very good tube in the last socket will make all the difference in the world.

Neither more nor much less "B" battery voltage should be used as the operating point of the audio frequency amplifying tube grid will in either case be driven to an unfavorable point on the grid-plate characteristic curve. If difficulty is experienced in making the uni-control oscillate, a small .00025 mfd. fixed condenser should be shunted across the primary of the first audio frequency amplifying transformer.

The last stage may be cut out by connecting the output (loud speaker) between the positive "B" battery terminal and the plate connection of the second audio frequency amplifying tube—thus placing the output in shunt to the primary of the second audio frequency amplifying transformer. Indeed a small binding post may well be soldered to this point in order to facilitate such a change. The last tube must be left in its socket however, or otherwise the first radio frequency amplifying tube filament circuit will be open. Of course, the base of a broken UV-199 tube may be fitted with a 50-ohm resistance between the filament studs and used instead.

We were really surprised at the lack of "ringing" noise from the tubes—indeed it is not noticeable when a loud speaker is used. But a point which should not be overlooked is the reaction of the sound waves from the horn upon the tube; this reaction causes an audio frequency "howl" which, while it may be considered as musical, is ear piercing and decidedly annoying.

To avoid this keep the "speaker" isolated from the set and if possible use a closed up cabinet with rubber feet.

Dry cells may be used for filament supply and four of them should be connected in series. Standard cells will last from 100 to 150 hours or about five weeks to two months at a rate of 20 hours a week.

Now about the parts: The radio frequency transformers cost approximately $6.00 each; the audio frequency transformers $3.00 each; the completely drilled subpanel with "spun-in" sockets about $8.00, and the condensers, potentiometer switch, and extras about $10.00. Thus the cost will be close to $40.00. (Incidentally the Kardon Products Company is located at 101 Varick Street, New York City.)

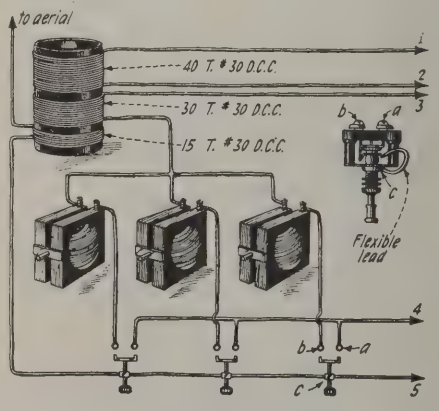
For the extras, 6 UV-199 or C-299 tubes list at $39.00, though a discount may possibly be secured on this quantity.

If the factor of low filament current consumption is not of major importance we would earnestly urge the use of two UV-201-A tubes in the second and third audio frequency amplifying stages; they will prove much superior to the UV-199. The only trouble will be to find a loud speaker that will stand the "gaff"! We personally have a Uni-Control at home for regular use with UV-201-A's as detector and audio frequency amplifiers and UV-199's as radio frequency amplifiers. The UV-199 tubes work excellently in conjunction with DX-Virbren radio frequency transformers and we can wish for no better receiver.

And More About the Push Button Receiver

Mr. Lee Galvin's "Push Button" set described in the January, 1924, WIRELESS AGE has already excited considerable comment; not from "DX" amateurs, but from people who are interested in the advancement and simplification of radio.

As noted, the description was of only a single adaptation of his system, and the slider method of tuning was selected merely because of its simplicity and low cost. Very good results have been secured with the original push button set, but it is quite necessary that the sliders be arranged to touch but one turn of the tuning coil at a time. This can readily be done by using a spacing cord of greater diameter than the wire. If the secondary coupling coil is not coated with some form of insulating fluid and if the secondary leads are very short, so that there is very little distributed capacity across the secondary, it becomes necessary to shunt a small fixed condenser from the grid condenser (terminal away from the grid) to the filament. This condenser should have a value of about .0001 mfd. and may be made by placing two .00025 mfd. fixed condensers in series.



A better arrangement for tuning is suggested in the sketch, which represents three variometers in a branched circuit; using Cutler-Hammer switches for selecting the desired branch. Potentiometers of 200 (or even lower resistance if they can be secured) may be used.

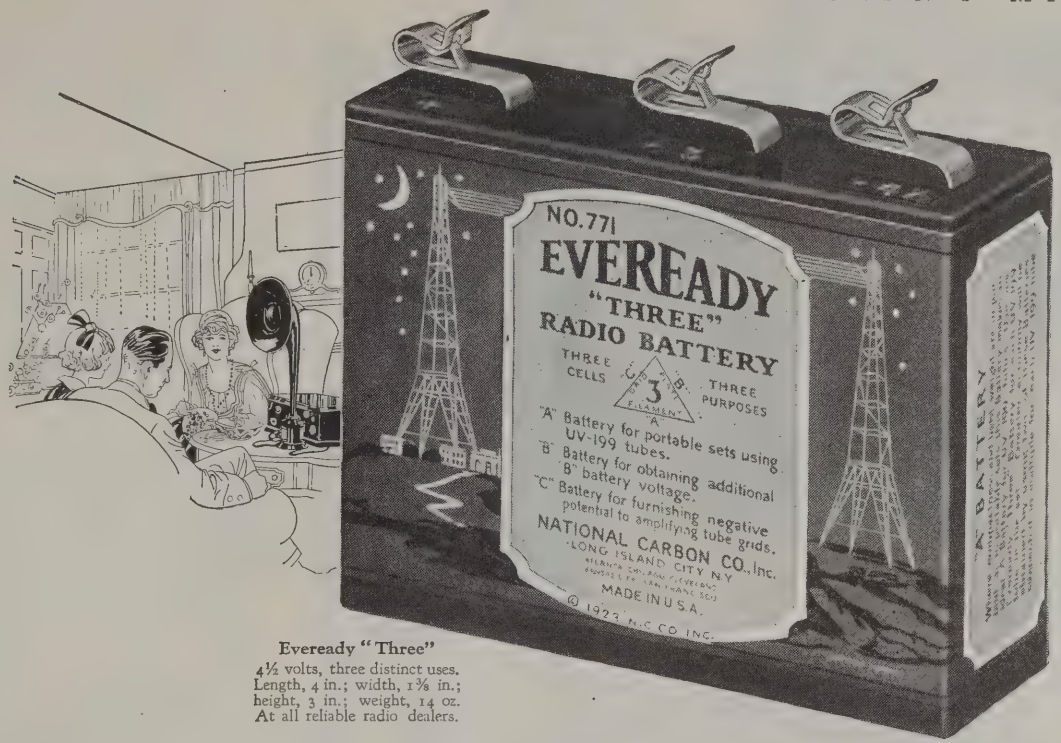
A. C. Filament Supply

Mr. Herbert Cosgrove of Troy, New York, writes: "I have noticed an advertisement of a device with which it is claimed alternating house current may be used for filament supply of a receiving set in place of the usual 'A' battery; what is this device composed of—is it practicable?"

Usually the devices you mention are made up of a step-down transformer to reduce the 110-volt house supply to 6 volts; a potentiometer of any resistance value connected across the six-volt supply; and three

(*Continued on page* 80)

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



Eveready "Three"
4½ volts, three distinct uses.
Length, 4 in.; width, 1⅜ in.;
height, 3 in.; weight, 14 oz.
At all reliable radio dealers.

This "C" Battery is a Wonder Worker

YOU can make the loud speaker respond with a new fullness and naturalness of tone. You can save money by adding months to the life of your "B" Batteries. These things you can do by using the new Eveready "Three" as a "C" Battery.

You already have an "A" Battery for the filament and a "B" Battery for the plate. A "C" Battery is connected to the third element of your vacuum tube, the grid, affording a control that is marvelous in action on audio frequency amplifiers.

As a "C" Battery the Eveready "Three" prevents distortion and excessive flow of current from the "B" Battery, lengthening its life. It is a wonder worker that saves its small cost many times over. Connect it in your audio frequency amplifier and note the difference. Full directions on the label and in "How to Get the Most Out of Your 'B' Battery," a booklet on "B" and "C" Batteries, sent free on request.

This triple-use battery can also be used as an "A" Battery in portable sets. Light and full of pep. Its third use is as a "B" Battery booster.

Use the Eveready "Three"—a tested product of the world's leading electro-chemical battery laboratory. It serves more radio uses and effects more economies than any radio battery heretofore developed.

If you have any battery problem, Radio Battery Information Headquarters will solve it for you. Write G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 198 Orton Street, Long Island City, New York.

NATIONAL CARBON COMPANY, Inc., New York—San Francisco
Headquarters for Radio Battery Information
CANADIAN NATIONAL CARBON CO., Limited *Factory and Offices:* Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

What's Inside
The most important thing to know about an amplifier is "What's Inside." Outwardly there is little vital difference. Inwardly there's all the difference in the world—the difference between clear, mellow reception and poor reception full of squeaks and squawks.
Many radioists unconsciously put the "squeaks and squawks" into their set through the use of improper transformers. They have yet to learn that "RATIO" means absolutely nothing—that 10 to 1; 9 to 1; etc., do not spell maximum amplification.

The very next time you buy an amplifier insist on a Genuine JEFFERSON for these reasons:

1st—A JEFFERSON is scientifically designed.

2nd—The windings are carefully calculated to produce 100% amplification—they are not built up to a ratio.

3rd—The JEFFERSON line embraces a variety of amplifiers to meet every demand—six Audio and two Radio Frequency types.

4th—As pioneer transformer manufacturers JEFFERSON Engineers designed audio amplifiers long before Radio reached its present popularity. You will appreciate JEFFERSON'S extra years of experience.

And remember this—the first cost of an amplifier is unimportant. Results count—buy an amplifier for what it will do—the service it will render—the tone and volume it will produce. Receiving is fun when one doesn't have a lot of pesky distortion to struggle with. You eliminate distortion when you use JEFFERSONS. Your set operates more quietly and clearly—the volume is greatly increased—distant stations are easily tuned in.

You are invited to write our Radio Engineering Department for amplification data. Attractive descriptive literature is also available. This service is gratis.

JEFFERSON ELECTRIC MFG. CO.

431 S. Green St. Chicago, Ill.

Jefferson Super-sensitive Amplifying Transformers

Aladdin's Magic Lamp

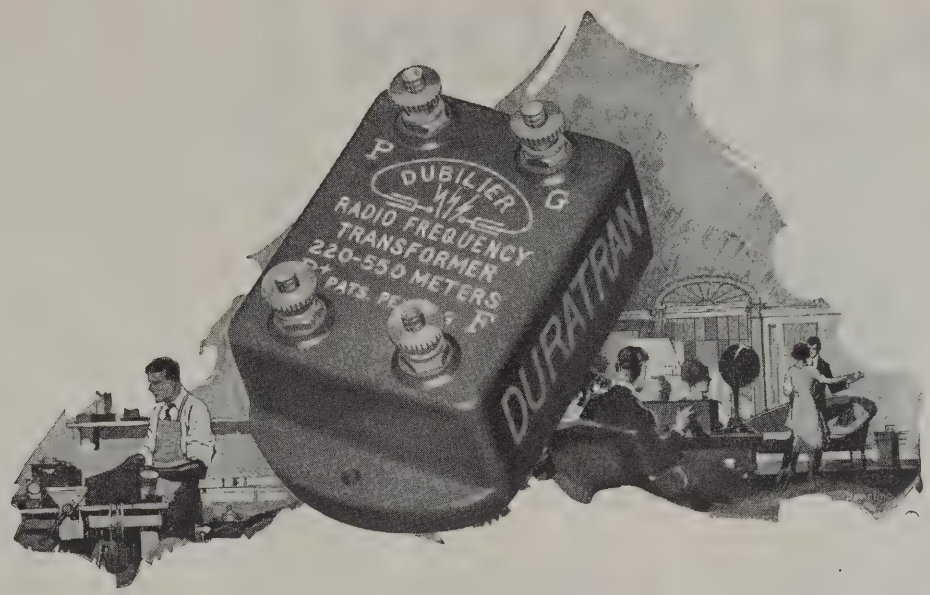
(*Continued from page 39*

voltages of either of these tubes; it is necessary merely to keep the filament current at or slightly below the normal value and to restrict the plate voltage to the limit indicated on the instruction sheet enclosed with each tube.

On the whole, better results for radio frequency amplification may be expected with storage battery tubes, i. e., those having a comparatively heavy filament current. And, of all the receiving tubes on the amateur market, the UV-201-A (C-301-A) is doubtless best for this purpose. The filament of this tube consumes but one-quarter of an ampere; the tube is an excellent amplifier, and it is remarkably quiet in operation.

As a detector, the UV-200 (C-300) is generally agreed superior to other tubes; especially if provision is made for smooth regulation of the filament current through use of vernier or carbon pressure rheostats. With this tube a tapped "B" battery of 15 to 22½ volts will prove of much benefit. Remember if the negative terminal of the "B" battery is connected to the positive terminal of the filament battery that the voltage of the latter (filament battery) must be added to the voltage of the "B" battery. In other words, if the plate battery voltage is 22½ and the negative "B" is joined to the positive side of a 6-volt filament battery, then the effective voltage on the plate (neglecting the external plate circuit resistance) will be 28½ volts with respect to the *negative* terminal of the filament.

There are two ways of obtaining the negative grid voltage; one method is to place the filament rheostat in the negative battery lead and connect the return lead from the grid to the negative side of the battery. (See the amplifier circuit with the chart.) In this way there is a difference of voltage between the negative "A" battery, to which the grid is connected, and the negative terminal of the filament. The value of this negative voltage depends upon the resistance of the rheostat and the resistance of the tube filament and the voltage of the filament battery. If the tube is a UV-199, the filament resistance of which is 50 ohms, with a 25-ohm rheostat and a 4½-volt battery, the voltage difference between the negative filament and the grid will be 1½ volts, which is the value of the voltage drop across the rheostat. The other method is to provide a special "C" battery in the grid return lead. The negative terminal should be connected to the grid, and the positive terminal of the "C" battery should be connected to the negative side of the filament.



The Dubilier Duratran

Amplification on all wave lengths

THE Dubilier Duratran is the supreme radio-frequency transformer. It amplifies powerfully and uniformly *over all the wave-lengths* now used by broadcasting stations.

Price $5.00

At all good dealers

DUBILIER CONDENSER & RADIO CORPORATION
48-50 WEST FOURTH STREET
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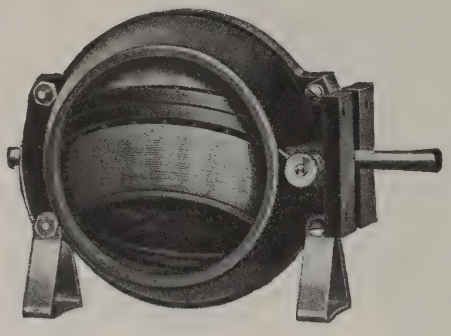
DUBILIER DEVICES

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS



Keep Abreast of the Times

Use a Paragon Variometer in Your Receiving Set

Every man who owns a Radio Receiving Set naturally wants to get the best possible results that can be obtained with it. To do so he must keep abreast of the times and add parts where they will improve it.

Paragon Audio-Frequency Amplifier Transformer No. 81 Reduces tone distortion, $5.00.

Wavelength bands now in force involve radio currents of extremely high frequency. An inductance unit of exceptional electrical and mechanical excellence is needed to obtain the best results on these wavelengths. The PARAGON No. 60 Variometer, ribbed design, assures the greatest possible efficiency at high frequencies and makes it far easier to secure desired results on wavelengths of 150 to 200 meters.

All PARAGON Parts are packed in distinctive Yellow and Purple Packages. They cannot be confused with any other packages on your dealer's shelves. Be sure you get the genuine.

The reduction of material in the support forms permits us to offer this essential radio part at an extremely popular price.

Add a PARAGON Variometer to your set. It will make it a better set and will increase your pleasure in listening in with it.

Illustrated Bulletins on Paragon Radio Products are yours for the asking

ADAMS-MORGAN CO., 8 Alvin Avenue, Upper Montclair, N.J.

The Wireless Age Reflex

(*Continued from page* 59)

One panel mounting socket. That shown, a "Bell," is entirely satisfactory, but there are any number of equally good ones on the market. For use with a UV-199, the Frost rubber cushioned type is suggested. For those who want the highest efficiency a porcelain socket is preferred.

One rheostat (Cutler-Hammer) of 30 ohms so a UV-199 tube may be used with a 4.5-volt filament battery. And as this rheostat will pass ¼ ampere safely it may be used with a UV-201-A; though the resistance with that tube and a six-volt battery need be no more than 4 ohms.

One crystal detector stand—see text for suggested type.

One front panel, standard size 7 x 12 x 3/16 inches. (Radion.)

One terminal strip 12 x 2 x 3/16 inches. (Radion.)

Two Quinby aluminum frames for 7-inch panel.

SMALL PARTS

Two small binding posts for connecting the crystal "detector."

Six large binding posts for terminal strip. (Eby.)

Six flat head 6/32, ⅝-inch brass machine screws.

Mounting screws for the variometers and the rheostat.

One-eighth pound of No. 30 double cotton covered wire.

Three strips of thin cambric tubing.

Ten feet of No. 18 soft drawn bare copper wire.

ACCESSORIES

One vacuum tube, UV-201-A, or else a UV-199—although any tube can be used.

One "A" battery of proper voltage for the tube to be used.

One "B" battery consisting of three blocks of dry cells giving 22.5 volts each or 67.5 volts total.

One antenna 60 to 200 feet in length, single or double No. 14 wire; porcelain insulated.

One ground, water pipe or buried wire.

One 2,000 or 3,000-ohm headset or a "speaker."

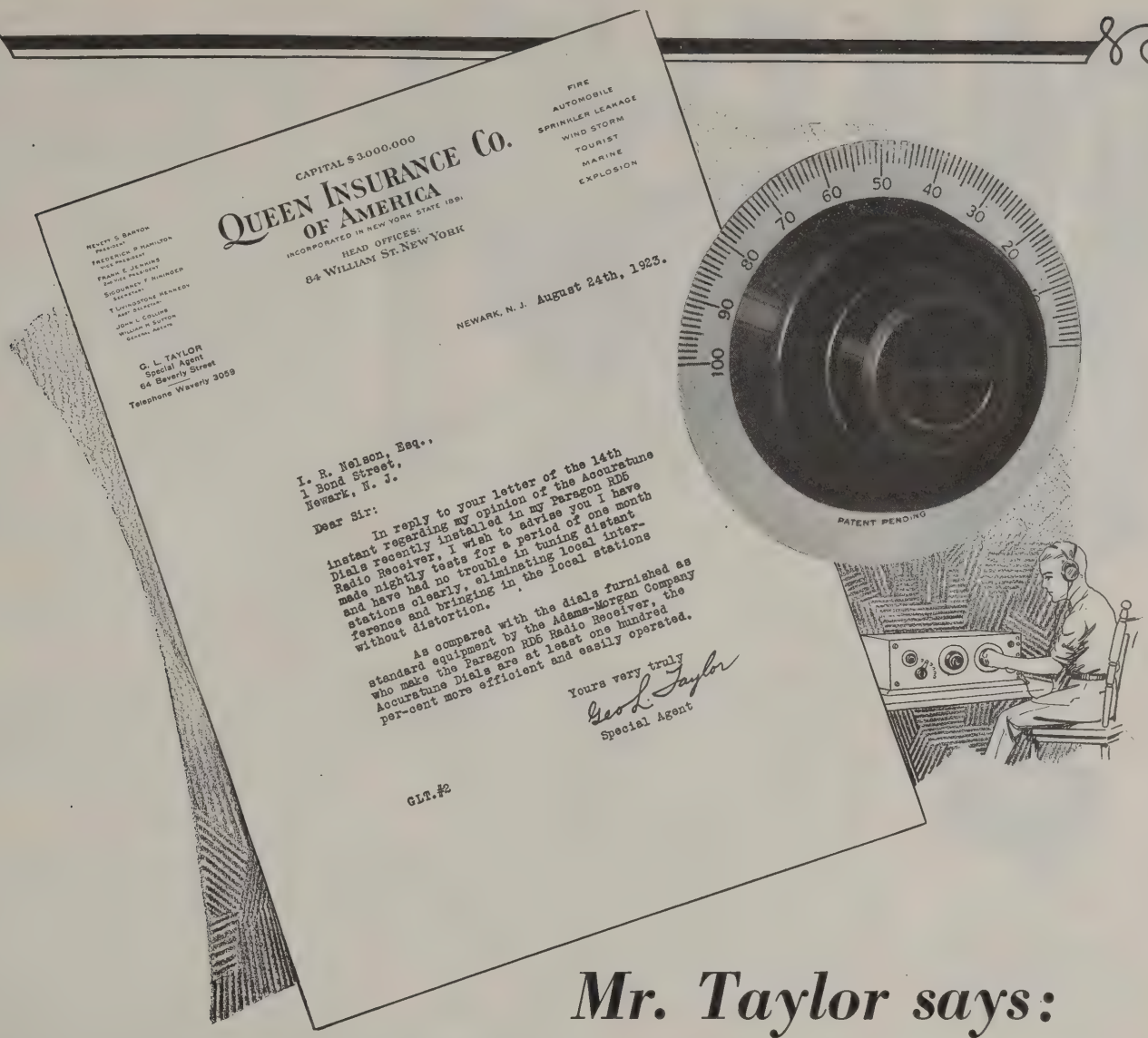
Junk This Radio Jargon

(*Continued from page* 54)

ly operative—and difficult! This number of circuits ought to supply that portion of the radio press that is willing to deceive the public for some weeks. One of these circuits ought to be called, in all due deference, the Pickard circuit!

Then when it comes to schematic diagrams, everyone seems to consider that unless a schematic diagram contains a horde of jacks and double-pole double-throw switches it is not worth printing. There is quite an art in schematic diagram work, the underlying idea being to show the actual features of the circuit in as simple a way as possible. This is apparently unknown to much of the modern radio press.

The real facts of the case are that much of the radio press of today is proceeding on the incorrect principle of government by a minority. A


CAPITAL $3,000,000
QUEEN INSURANCE CO.
OF AMERICA
INCORPORATED IN NEW YORK STATE 1891
HEAD OFFICES:
84 WILLIAM ST. NEW YORK
FIRE
AUTOMOBILE
SPRINKLER LEAKAGE
WIND STORM
TOURIST
MARINE
EXPLOSION
G. L. TAYLOR
Special Agent
64 Beverly Street
Telephone Waverly 3059
NEWARK, N. J. August 24th, 1923.
I. R. Nelson, Esq.,
1 Bond Street,
Newark, N. J.
Dear Sir:
In reply to your letter of the 14th instant regarding my opinion of the Accuratune Dials recently installed in my Paragon RD5 Radio Receiver, I wish to advise you I have made nightly tests for a period of one month and have had no trouble in tuning distant stations clearly, eliminating local interference and bringing in the local stations without distortion.
As compared with the dials furnished as standard equipment by the Adams-Morgan Company who make the Paragon RD5 Radio Receiver, the Accuratune Dials are at least one hundred per-cent more efficient and easily operated.
Yours very truly
Geo. L. Taylor
Special Agent
GLT.#2
PATENT PENDING

Mr. Taylor says:

"No trouble tuning distant stations"

Universal micrometer action and easily fingered knobs are the outstanding features of the Accuratune Control. The larger knob is used for coarse adjustments, the smaller knob operates the micrometer mechanism. Either action will swing the dial through the full 360 degrees. Your dealer will supply you with Micrometer Controls for your present set, or if you buy a new set, choose one equipped with Accuratunes.

HE is pleased not only in this capacity, but he adds that he has no trouble tuning CLEARLY.

It is no little stunt to bring in a distant station, with all local and other disturbances in the air. But with an Accuratune fine adjustments are easy, and the slightest turn of the micrometer knob will throw interferences out of the way, and bring in the station you want CLEARLY. The Accuratune is not a mere dial, but an actual Micrometer Control ten times more efficient than any tuning device.

For such satisfactory reception the Accuratune was created, and though the price be slightly higher than ordinary dials, it will prove its worth the first time you use it.

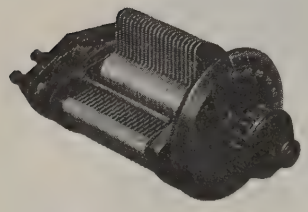
MYDAR RADIO COMPANY
9-A Campbell Street, Newark, N. J.

Manufacturers of Popular Sets. Equip your apparatus with Accuratune products. Increased efficiency and beauty will advance your sales.

ACCURATUNE

MICROMETER CONTROLS

EVERY ACCURATUNE PRODUCT IS A GOOD PRODUCT



Gilfillan *and* Bakelite

All the molded insulation of these Gilfillan radio parts is 100% Bakelite.

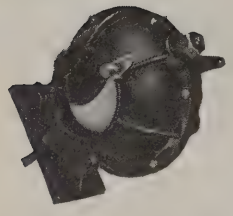
In the words of the manufacturer, BAKELITE "insures positive insulation and absolute permanency." And that's the story in a nutshell.

Nothing else equals Bakelite in the combination of all its desirable properties such as insulation resistance, mechanical strength, permanence of color and indifference to all weather conditions.

The outstanding merit of Bakelite is its durability—its freedom from deterioration.

Every day, radio men are finding new applications for this "Material of a Thousand Uses," for parts made of molded or laminated Bakelite possess properties that successfully meet the most exacting demands of radio work.

Write for a copy of our Radio Booklet A.



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Send for our Radio Map

Enclose 10 cents to cover mailing cost and we will send you a large Radio Map which lists the call letters, wave length, and location of every broadcasting station in the world.

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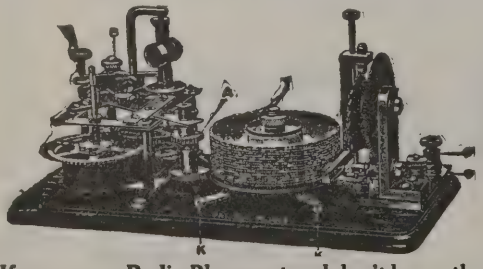
THE MATERIAL OF A THOUSAND USES

Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"



THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. **THE OMNIGRAPH** is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. **THE OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses **THE OMNIGRAPH** to test all applicants applying for a Radio license. **THE OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models, $14 to $30. DO IT TODAY.

THE OMNIGRAPH MFG. CO.
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If you own a Radio Phone set and don't know the Code—you are missing most of the fun

couple of years ago, the amateur was in the saddle, and to the amateur complexity is indeed dear. Today, the ranks of the amateur are about as unity compared with ten for the radio listener, and the latter is gaining day by day at a far more rapid rate than the former. The amateur, I hope, we will have with us always. He forms the nucleus from which we professional Armstrongs and Godleys graduate. But some one must recognize that for the newcomer, who does not even speak the technical jargon, the present complication in the press merely confuses while it does not enthuse. For him there must be a Moses, leading him out of the wilderness with real facts, simply stated, with the fundamentals of this wonderful new art stated in terms of his understanding. Then, and then only, we will have common sense in radio.

How to Be a Radio Salesman

(*Continued from page 33*)

book very quickly showed that they did, for the salesmen were given a commission in addition to their salaries. What was more important, however, they showed that he was not merely a machine connecting the shelves with the counter.

You have had the experience probably, of buying a collar in an emergency, when you needed only one because you had plenty at home. Yet the clerk tried to sell you half a dozen or at least two. Failing that he rattled off a list of shirts, socks, neckties and handkerchiefs. But not Charlie. He managed something like this:

A man dropped in for a socket to put in a new set. Without openly delaying about producing the type of socket asked for he took out of the case one of a more expensive make. "There's one with better contacts and better insulation on the base." Then without stopping he went after the kind the man specified. Seeing the good one first the other suffered by comparison. If the customer said he liked it, but it wouldn't fit there was no argument. The next shot:

"Have you got an amplifier for your set?" If not—"Here's a new issue of the 'Radio Wave' with some good dope on a two-step. You'll find there all the construction dope and a complete list of parts and prices. Better take this along so you'll have the article when you're ready to put on an amplifier.

"When you're ready to build it I can give you all the parts and help you out if there's anything that puzzles you. By the way if you haven't decided exactly on the details of your set look over that set of blue prints on the wall.

Build Your Own Radio Set!

—It's Easy—with

KARDON

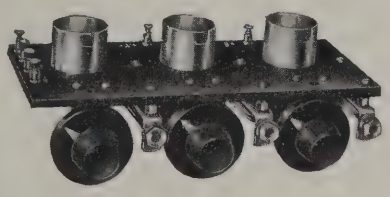
RADIO UNITS

There isn't any guess work in making receivers if you use Kardon radio units, because Kardon units come to you all assembled, wired up and TESTED ready to operate.

You can use Kardon units with any circuit and with any tuning devices.

Your just add the tuner you want.

And you are assured of 100% satisfaction with any Kardon products. They are absolutely guaranteed.



Kardon detector and two stage audio frequency amplifying unit. Mounted on sub-panel, sturdy spun-in sockets; smooth running rheostats and special circuit jacks. This can be used in any circuit and it is easy to mount in your set.

Recommended by experts.

Mail the Coupon Now!

KARDON PRODUCTS CO.
101 Varick Street, N. Y. C.

Without obligations please send me the new Kardon Radio Unit catalogue.

Name .....

Address .....

Mahoganite has the Beauty of Polished Mahogany

Mahoganite Radion Panels have a satin-like finish comparable to that which age and a skilled cabinet maker give to mahogany. Radion Dials and Knobs are also made in Mahoganite to match.

At all good dealers or write to

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RADION

The Supreme Insulation

PANELS

Look for this stamp on] every genuine Radion Panel. Beware of substitution and imitation.

ANNOUNCING
THE NEW
DOUBLE CONE BEARING
IN THE
THORDARSON
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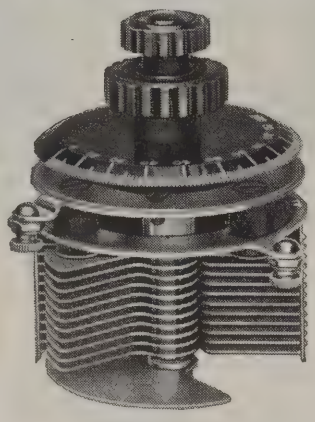

VERNIER PRICES

13 Plate .00025 mfd.	$3.50
23 Plate .0005 mfd.	4.00
43 Plate .001 mfd.	4.50

PLAIN PRICES

13 Plate	$2.00
23 Plate	2.50
43 Plate	3.00

The new double cone bearing of the Thordarson condenser combines smooth operation with rigidity. The possibility of side play is entirely eliminated. This is a metal bearing and will not wear out.

OTHER FEATURES

1) Completely shielded against body capacity and dust.
2) All plates accurately spaced by machine.
3) Single metal bearing secured to shielding plate without any dielectric.
4) Hard rubber insulation is used throughout.
5) Lowest possible zero capacity and dielectric loss.
6) Drilling template furnished with every condenser.

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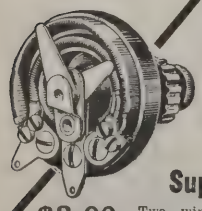

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They are for building the set you see at the end of the counter." If the customer went to look at the prints Charlie made a quick decision. If the man was going to buy the prints, and some more parts, he stayed with him, but if he expected the customer to glance over them, return, and say, "No, I guess that's all," he started with the next customer. However, he did not try to wait on two customers at a time letting first one stand around and then the other. Instead, with a second customer waiting for him, he had the regular "Good morning sir," and "if you can wait two or three minutes I'll be with you."

Think of your own feelings when you go in a store to buy. With all the afternoon ahead of you you become impatient if the clerk pays no attention to you, but if you are asked politely to stand by to be attended next though you may think the other man is slow in making up his mind you don't blame the clerk for keeping you.

Charlie's salesmanship succeeded because he never forgot that his salary came from the money he took in; that the goods were not in the store for exhibition or to be played with; and because he sold others as he liked to have others sell him. He soon had friends among the experimenters, but he seemed to discipline them in a way that made them respect him. Many people came to him for advice and suggestions. He told them what they wanted to know and usually sold a book which covered the points in question. He was friendly without being sociable. While watching everything loose on the counter he never appeared suspicious.

But unfortunately for us he soon outgrew his job behind the counter. Within a year he was back in Fort Worth, operating a store of his own. At least it is a store within a store. If you ask for the radio department at Stripling's you will find Charlie Farris on the job, the old smile and the bright "Good morning," still making friends, while parked behind the building is a snappy-looking Buick sedan waiting to take him home to lunch; for Charlie was one of those boys who in order to make a success of radio selling put in the work which success requires.

Little Journeys Into Radio Computations.

(*Continued from page 37*)

in the same units of meters, microhenries, and micro-microfarads. Now, if the inductance varies as the square of the number of turns, and the wavelength varies as the square root of the inductance, as shown by (7) and (8), then it follows that the wavelength varies directly as the number of turns. This affords a very useful short-cut in

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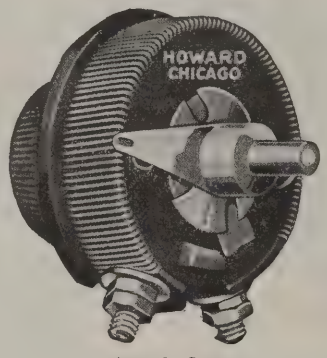
The Midget



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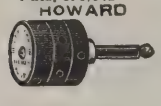

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computation, for it means that when we have a coil of a known number of turns which has been found by test to tune to a certain wavelength, in order to reach a higher wavelength all that is necessary is to increase the turns in the same ratio. For example, given the trap described above, using a 25-turn coil and a 0.0005 mfd. (500 mmfd.) condenser, which can be used as a rejector up to about 300 meters, how many turns will be required to trap out marine stations on 600 meters, instead of amateurs? For the latter purpose the circuit must be capable of tuning to 700 meters maximum. The ratio of 700 to 300 is 2.33 approximately. The number of turns required is therefore 2.33 times 25, or 58 approximately. A 60-turn spiral will therefore fulfill the conditions. In the same way the required number of turns for any other wavelength may be found almost instantly.

For parallel plate condensers the case is different. The wave length, as we see from (7) and (8), varies as the square root of the capacity. The capacity of any system depends, in general, on the area between the surfaces. But in a parallel plate condenser the effective area increases directly as the total number of plates, minus one. Hence the wavelength goes up as the square root of the number of plates, and if we substitute for a 23-plate condenser one of the same size, but with 43 plates, the new maximum wave length will be only 1.41—the square root of 2—times the former. The subject of calculation of capacities is treated adequately in the circular on

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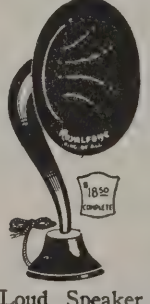

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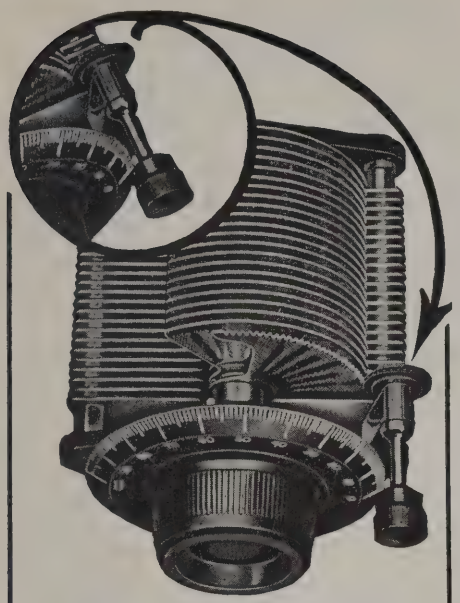

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Separate vernier adjustment — reducing gear meshed into teeth cut in rim of vernier plate. Ordinary adjustment reduced to infinite fineness. Absolutely positive adjustment—without backlash.

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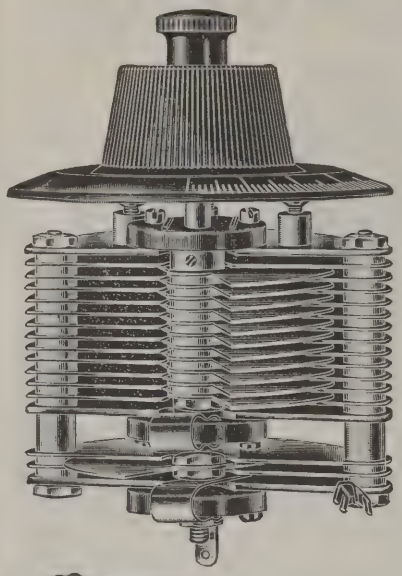

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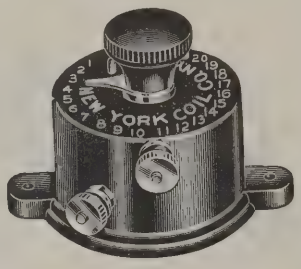

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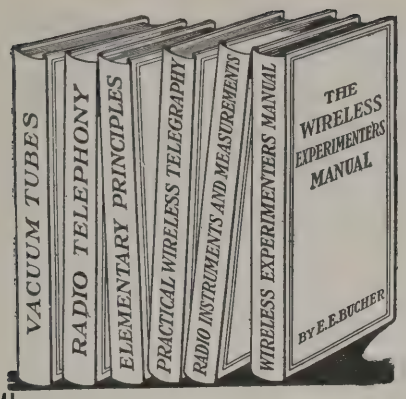
A word is in order about the general relation of mathematics to radio. Mathematics, being a specialized form of exact thinking, with its own rules and technique, is very distressing to many people. Just as many broadcast listeners are interested only in what radio can bring them, and refuse to bother with technical terms and procedures, so numbers of experimenters, who are trying eagerly to become competent technicians in the new field and are garnishing their conversation with so many engineering expressions that their friends can no longer understand them, balk at the exact statements and analyses which constitute practical mathematics. The position of the non-technical BCL's is, however, strictly logical; they demand the product and are willing to pay others to develop it. The experimenter who shies at an equation is in a much less tenable position. He wants to know how the thing works and why, and at the same time he discards the only means of definitely arriving at the answers to these questions. This gets him nowhere. There is no royal road to knowledge, and in order to solve physical problems one must use the specialized form of logic developed for that purpose. For most purposes, in the radio field, an acquaintance with simple algebra is sufficient. Whatever fourth dimensional calculus may be, algebra is not a forbiddingly difficult subject; anyone who really wishes to can learn it and make himself independent of the cumbersome analogies and picture puzzle devices which encumber the semi-technical press. Hydraulic analogies and the like have their place, and I do not mean to criticize their use, within limits, and as auxiliary methods of teaching; but outside of their proper sphere they merely complicate the problems they attempt to deal with. For those who are seriously interested the best procedure is to learn the proper method in the first place.

Information Desk

(*Continued from page* 68)

terminals—two of which are marked "filament" and connected to the six-volt supply and the other marked "grid" which is connected to the slider of the potentiometer. (See 2.)

When the slider is adjusted to the midpoint of the resistance there is no voltage variation at this point. Therefore, if all return leads to the filament from the plate and grid circuits are connected to the slider, the voltage on these electrodes will not vary as would be the case if the return leads were brought to either side of the filament. It is not necessary to use a potentiometer;



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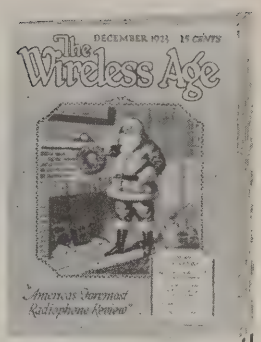

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How to Conduct a Radio Club	E. E. Bucher	.75	10
Alexanderson System	E. E. Bucher	1.25	18
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The Audiophone is complete and self-contained—needs no separate battery or other accessories—goes to you ready for use on connecting to your receiving set. It will prove a source of lasting pride and pleasure.

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the center or neutral point may be obtained by a center tap on the secondary of the transformer or by a suitable arrangement of the filament circuit as shown at (1). However, best results may be had by use of a potentiometer.

A few years ago we conducted numerous experiments with this arrangement and found that it was well to limit its use to one tube (preferably in a regenerative detector circuit) and that the filament should have slow heating qualities so that the rapid variations in filament supply would not appreciably affect its temperature, for otherwise the plate current would vary in accordance with the filament fluctuations. It was found advisable to have a condenser in the ground lead—or use a counterpoise—rather than a direct ground.

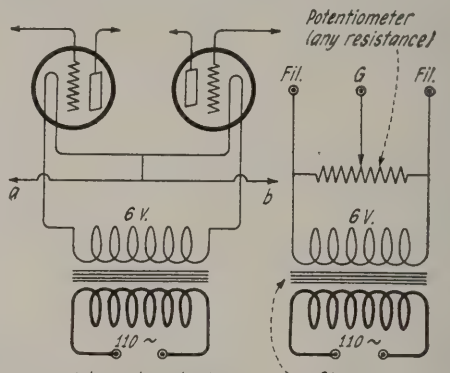

Fig. 1 Fig. 2

As to the practicability of this system we would hesitate to recommend its use to any but experimenters, especially as much superior results may be had with the "dry cell tubes" now on the market.

Are "By-Pass" Condensers Necessary?

Mr. Frank Johnstone of Chicago, Ill., writes: "In a recent issue of THE WIRELESS AGE, *I notice several diagrams in which 'by-pass' condensers are not shown—why is this?"*

They were omitted because they were not necessary. We have found, in countless experiments, that on the whole by-pass condensers are uncalled for—provided the low frequency output is located in the low potential side of the radio frequency section as it usually is. In reflex circuits the condensers spread here, there and everywhere are usually unnecessary as the writer has proved not only to himself, but to many people in radio.

Incidentally the omission of unnecessary parts is one of the main endeavors of the Technical Department.

Storage Battery I. C. W. Transmitter

Mr. H. E. Boyle of New York wants: "a diagram of an I. C. W. transmitter with a six-volt storage battery for the filament and plate supply."

We are showing on these pages a circuit diagram of a one-tube transmitting set using a "spark coil" operated from a storage battery for plate supply.

The inductance may be wound on a form 4 inches in diameter with 40 turns of No. 18 wire spaced about 1/16 inch. Taps are made from the plate end of the coil to the center at every other turn. The filament is connected to the center tap. The tuning condenser should be one that can safely stand moderately high voltages and should

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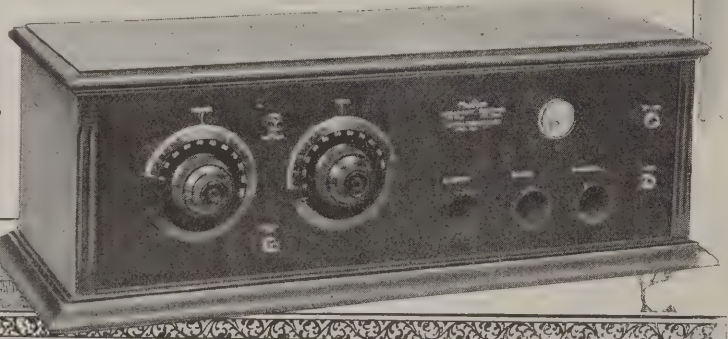

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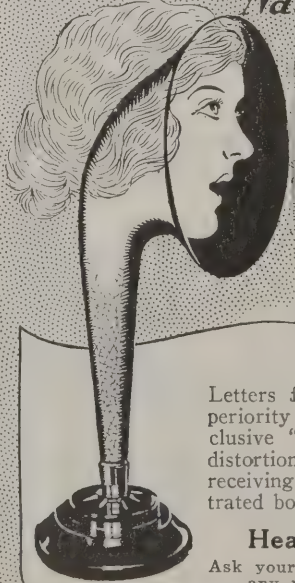

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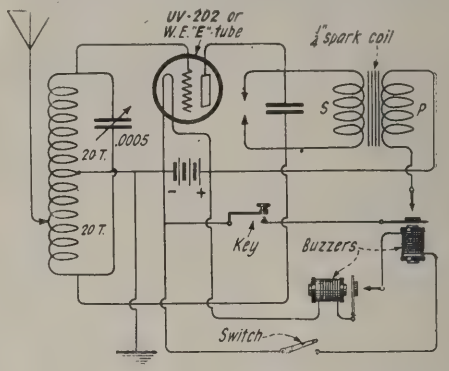
be of good electrical and mechanical design, of course. A porcelain tube socket is preferred.

Either a small ¼-inch spark coil or a specially designed step-up transformer can be used in the plate circuit. The vibrator is screwed down tightly and two buzzers are arranged to make and break the primary circuit. By placing the key in the indicated position there is less chance of the contacts "sticking"; consequently a pleasingly smooth tone can be secured.



The value of the condenser across the secondary should be sufficient to reduce the plate voltage to a safe point; this can be determined experimentally by adding capacity till there is no "spark over" in the tube.

Connections to the secondary of the spark coil should be turned about for best results.

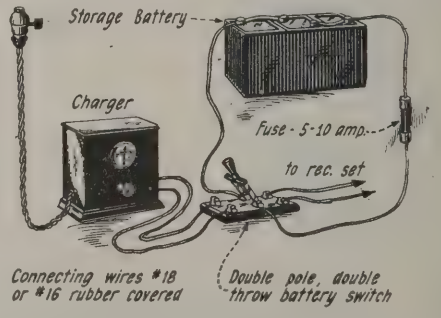
The equipment may be mounted on a hard wood base about 10 inches long and 8 inches deep. If desired the tuning condenser and switch (together with an 0-1 antenna ammeter) may be mounted on a small front panel. Wiring may be of No. 18 or heavier hard drawn copper wire.

Much additional construction and operating data on all types of modern C. W. transmitters may be found in "Radio Telephony for Amateurs" by Stuart Ballantine, published by The Wireless Press, New York.

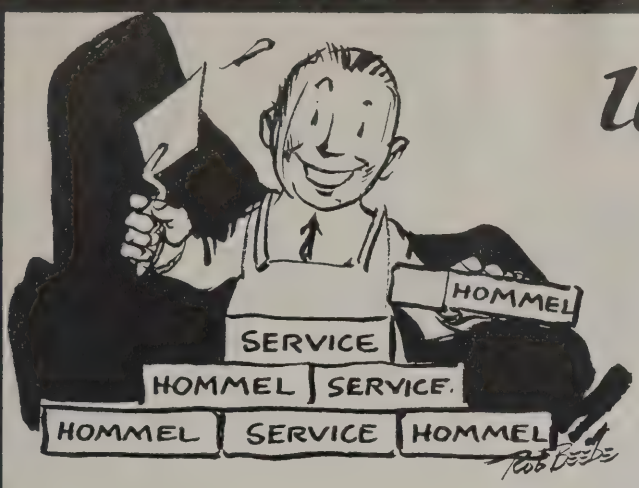
No Fussing With This Battery Switching System

Mr. O. W. Holmes of Dallas, Texas, writes: "Please publish a circuit diagram of a battery switching arrangement which will enable me to throw the 'A' Battery on or off charge instantly."

A suitable circuit is shown on this page. A double-pole double-throw battery switch is employed; the two center contacts are



connected to the "A" battery with a fuse in one line. Two of the remaining contacts on the switch connect to the charger while the last two switch contacts are connected to the filament battery binding posts on the receiver.



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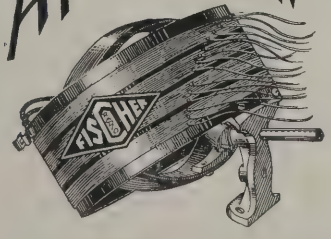

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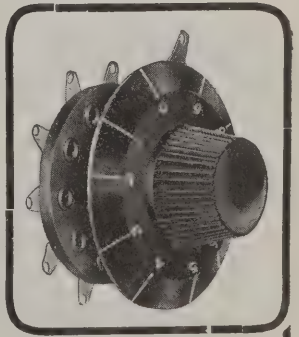

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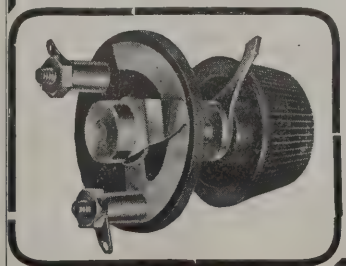

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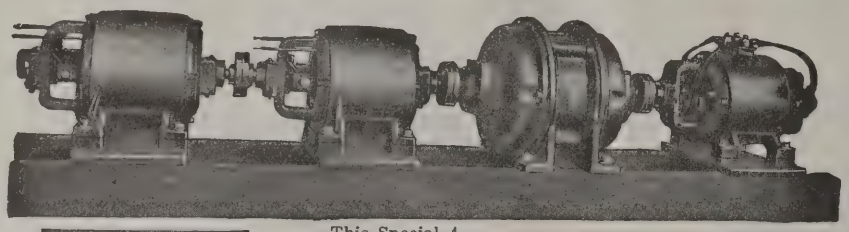

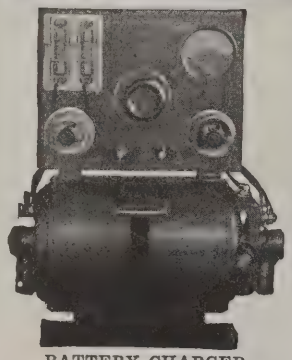

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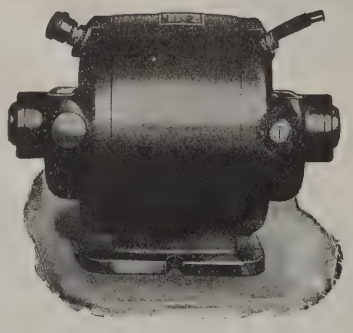

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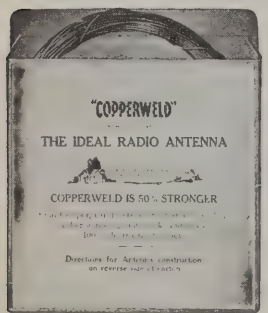

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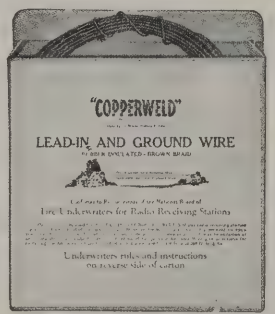

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8YAE, 8ZE—OBERLIN COLLEGE, Oberlin, Ohio.

(1ajx), (1aqi), (1aze), (1bhk), (1biz), (1cki), (1il), (1ju), (1mp), (1zd), (2aco), (2anm), (2auy), (2ax), (2beo), (2bgd), (2bms), (2bqh), (2cfb), (2cqd), (2chq), (2cvj), (2bms), (2bqh), (2cfb), (2chq), (2cvj), (2cwj), (2cxl), (3ajg), (3bfs),) (3bva), (3blc), (3cbl), (3cbv), (3cg), (3cn), (3sp), (3wf), (4eb), (4hs), (4jk), (4mi), (4mv), (5amh), (5gj), (5in), (5nl), (5uk), (6xb), (5zav), 6bm, 6ec, 6ez, 6gt, 6gr, 6if, 6ii, 6ka, 6kg, 6lv, 6sk, 6zh, 6zw, 6zv, 6aak, 6afq, 6akz, 6alk, 6aos, 6apw, 6arb, 6aru, 6avv, 6awt, 6bbc, 6bcl, 6bck, 6bic, 6biz, 6bkx, 6bmc, 6bnc, 6bnt, 6boe, 6bqb, 6bua, 6buo, 6bum, 6bve, 6bvg, 6cbw, 6cdg, 6cgd, 6cfm, 6cgw, 6chl, 6cib, 6ckp, 6ckr, 6cmh, 6cmr, 6dlf, 6xad, 6zar, (x6tv), 6zba, (x6cfi), 7abb, 7adr, 7afo, 7bj, 7co, 7hg, 7it, 7iw, 7ot, 7px, 7zg, 7zu, (9aav), (9adw), (9amz), (9ape), 9apf, (9aps), 9avs, (9awk), (9ayp), (9bav), (9baz), (9bgi), (9bfi), (9bhn), (9bkb), 9bji, (9bjl), 9bjk, (9brk), (9brt), 9bto, (9chn), (9clq), (9crx), (9cyf), (9daw), (9dc), (9dkv), (9dky), 9dqh, (9dxl), (9eak), (9ebt), (9ehm), (9ej), (9elq), (9mf), (9ot), (9zt).

Canadian—(2bn), (2cg), (3ia), (3xn), (3bm), (3om), 5cn, 5go.

RAYMOND GROEBE, Elizabeth, N. J. (December).

4ai, 4aq, 4ay, 4db, 4eq, 4hs, 4ja, 4jz, 4ob, 4sm, 5aac, 5adh, 5ahj, 5aiu, 5ama, 5amh, 5bm, 5ek, 5er, 5ht, 5iu, 5kr, 5lr, 5na, 5nn, 5ov, 5qd, 5qw, 5vv, 5xk, 5xas, 6ajr, 6aol, 6avv, 6bfg, 6bqk, 6bua, 6bvs, 6cfz, 6cgw, 6chl, 6cmr, 6cnl, 6fp, 6lv, 6zh, 7adh, 7bj, 7co, 7lu, 7zd, 7zu, 9aar, 9apf, 9aqb, 9avn, 9avf, 9awd, 9bji, 9blg, 9boo, 9bri, 9bto, 9bzg, 9ccn, 9ccs, 9ccz, 9cga, 9ckm, 9cmk, 9czg, 9daw, 9dfh, 9dgi, 9did, 9dlm, 9dlw, 9dof, 9dqu, 9ear, 9eea.

Canadian—1dd, 2am, 2be, 2bg, 2bn, 3nf, 3ni, 4cl.

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VOLUME XI MARCH, 1924 NUMBER 6

RADIO

AND THE GIANT OF THE AIR

BCL's Safeguarded the Nation's Pride In Her Struggle With a Winter Storm

In a Polar Expedition Radio Would Control the Shenandoah

By William A. Hurd

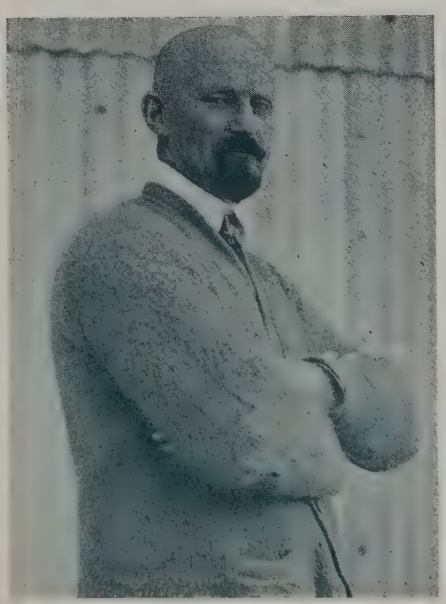
THE Shenandoh idled at her mooring mast—a giant ship 680 feet long, swinging at a height of nearly 200 feet above the earth.

Twenty-one of her crew had just gone aboard.

Gunner Robertson, a radio expert from Washington, D. C., had come to the Naval Base at Lakehurst, New Jersey, to replace the radio-compass experimental apparatus on board the Shenandoah with the permanent wireless station that would be the equipment used on her Polar expedition.

The transmitting apparatus was designed for sending continuous and interrupted continuous electric waves by the use of a rotating segment wheel. Six vacuum tubes were employed, supporting an input energy of 300 watts and an average output of 150 watts. The operating wavelengths were to be 507, 600, 800 and 975 meters.

The antenna consisted of 300 feet of trailing wire that could be reeled up as the airship approached the earth. The ground connection was to be effected by using the framework of the dirigible.



Captain A. Heinen, test pilot, the hero of the wild ride

The receiving instruments, of the two-circuit type, employed three stages of radio frequency, two of audio frequency and a detector. The six tubes were SE-1444, Navy type. The long distance receiver was to operate on a range of 500 to 30,000 meters. Telephone jacks were arranged to allow the use of either radio or audio amplification in one or two stages.

A gasoline-driven generator, differing from the usual fan-driven generator for aircraft, was to be installed for the source of electrical energy. A storage battery was included which would supply power for about two hours in the event that the generator failed.

The installation work was well

Naval operator at the radio station at Lakehurst. The receiving set shown is the navy type employed at most of the naval land stations

Left, G. C. Schnitzer, chief radio operator at Lakehurst. Right, Gunner J. T. Robertson, the only radio operator aboard the Shenandoah when she broke away from her mooring. These two maintained communication between ship and station

under way, lacking but an hour or two for completion.

The lonely figure of a syndicate press correspondent lounged about the foot of the mooring mast. For days he had remained at his post hoping for some scrap of news. But there had been none for his pains, nor could the busy attachés of the Station pause to offer encouragement.

A wind whipped across the landing field, threatening, ominous. It seemed to pause, and then settled down to gale force. Rain followed. The wind increased in velocity.

And suddenly, a forty-mile gale swept down. But the giant airship rode easily at her mast.

Lieutenant Nelson, in charge of construction, stepped to his front door to reassure himself as to the safety of the Shenandoah. Through driving sheets of rain that reflected the light from his doorway he could get an occasional glimpse of the ship, swinging fitfully for brief moments, but apparently riding out the gale serenely enough. He was satisfied that adequate proof of her eligibility for the Polar flight had been established.

But the wind leaped to seventy miles an hour as he watched. A ripping crash brought a startled exclamation to his lips.

"There she goes!"

A figure tore its way through the blinding storm. For a moment, Lieutenant Nelson's gaze was averted and held by the apparition dashing madly toward the house. And then he recognized the figure.

It was the press correspondent! And he had every intention of reaching a telephone, quick!

Lieutenant Nelson again looked for the Shenandoah. But the great ship had been swallowed by the darkness.

Grabbing his coat he dashed over the scrub oaks and shrubbery intervening between his house and the mooring mast. An immediate attempt was made to establish communication with the ship. But the effort was futile as the alterations in progress at the breakaway had not been completed. The operator at the land station could only wait and listen.

Lieutenant William Nelson, in charge of construction at Lakehurst

The next move was to telegraph a brief message to WEAF, New York, explaining the plight of the Shenandoah and request that information of her position be sent to Lakehurst as soon as lookouts could be put on watch throughout the Eastern States.

WOR, Newark, New Jersey, was in turn notified by WEAF, followed by a general alarm to broadcast stations along the coast. All broadcasting in the East was immediately shut down.

But it soon became evident that WOR could render a real service to the Shenandoah because that station happened to be strategically located for accumulating reports from points in the probable course of the ship. Government rules forbade broadcasting while a ship was in distress. A quick decision was needed. And it was made.

Putting on full power, the announcer broadcast a report of the situation as it was known, and requested that B. C. Ls. should listen and watch for the Shenandoah and telephone any information that would indicate her position.

So far, all that could be done had been done by wireless.

Broadcast listeners had been stimu-

Insert, Commander Frank McCrary, in charge of Lakehurst station. The Shenandoah at her mooring mast. This giant is the largest rigid airship in the world—nearly as long as the Woolworth building is high. The radio call ZR-1 will be changed to NERK if the ship goes on the contemplated North Pole trip

lated to the full realization of the powerful drama in which they had become active members of the cast. Reports began to pour in to WOR, and the whereabouts and probable condition of the Shenandoah was expeditiously relayed to Lakehurst.

In the studio, pandemonium reigned. Telephone calls from all points cluttered the switchboard. Some people wanted further details. But the most helpful calls came from the Plainfield section where it apeared the Shenandoah had won against the wind and was heading toward Newark on a starboard tack, fighting her way valiantly.

Someone in Westfield had heard a terrible crash and had forthwith notified the police and fire departments that the dirigible had struck, and protested against such an outrage.

An old lady telephoned to protest against the wanton negligence on the part of the government for sending the poor sailors out on a night like that and insisted that airplanes should be dispatched at once to tow in the crippled airship.

A small party from the studio went up on the roof to watch for the Shenandoah. They had to crouch behind a parapet and clutch at any available support to keep themselves from being swept from their feet. They searched the sky with eager eyes, but could only hear the muffled roar of the ship's motors circling around the city.

Suddenly, the giant form of the dirigible seemed to drop from the clouds directly above them. And the rain-soaked figures rushed down to the microphone to broadcast the information that the Shenandoah was well under control with all of her six motors running smoothly.

It was a thrilling moment for the broadcast listeners. The fate of twenty-one lives and a million dollar project, that night, depended upon a science held in the palms of unskilled hands. The B. C. Ls. had all been involved in the great event that marked another epoch in radio development.

Commander R. D. Weyerbacher, U. S. Navy, designer of the Shenandoah

Aboard the Shenandoah, before the breakaway, the crew had been busily engaged with routine matters. A man stood over each motor, oiling and polishing the mechanism.

In the control car, Commander Pierce and Captain Heinen were engaged with the delicate manipulation of the various instruments. Behind them Gunner Robertson labored with the final installation of the wireless equipment.

A violent lurch of the ship threw them headlong into the bulkheads. The cry went up as of one voice:

"There she goes!"

Captain Heinen jumped to the control lever and released 4,000 pounds of water ballast from the bow. The ship backed off toward the woods just west of the mooring mast. Her nose continued to rise until she stood at an angle of 60 degrees. For a moment it seemed that her tail must have caught in the trees.

Three huge gasoline tanks were let go, but the dirigible stood at such a precipitous angle they struck a main strut and carried it away with so much force the giant ship trembled. But she rose.

While the officers struggled to sta-

Trying to signal to the Shenandoah by flash light on the roof of station WOR. The announcer stood in a driving rain storm in constant danger of being swept from the roof by the 70-mile gale

bilize the Shenandoah in the seventy-mile gale, the men at the motors strained to get them started.

Captain Heinen refused all reports of the actual damage, preferring to "feel" the situation by the performance of the ship under his guidance.

The two forward gas bags had been destroyed when the nose pulled off at the mooring mast. And the third bag had sprung a leak. But Commander Pierce stood in the gap at the bow to patch the weakened section. Little else than nerve stood between him and death. But so, likewise, he stood between the crew and death.

The lone operator realized that radio communication was vital. But the quick assembly of the wireless equipment was seriously hampered by the violent lurching of the ship. Before long the work became a sort of dogged routine.

Powerful searchlights began to sweep the sky, seeking the Shenandoah as a result of the report broadcast by WOR. The lights served, in some measure, to guide the course of the stricken ship.

It was 6:52 when the dirigible left her mast. A 8:20 the first news of her whereabouts reached the Naval Station.

But at 9:10 the first message from the Shenandoah was received. It seemed like the voice of the ship herself speaking out to tell them at Lakehurst that she would soon be back.

"All O. K. Riding out storm. Over New Brunswick. Verify position. send us weather information."

The ship's radio was working!

Weather information was most important. Radio on radio was sent to the ship to supply them with weather predictions from all government bureaus in the east. Her positions were included in those reports.

The only links between the ship and her mother station were the messages exchanged. Communication kept up the spirit of each group.

And as the courageous crew managed to swing the ship around, nose into the wind, and finally make headway homeward, the landing gear at the station was prepared for receiving.

Word came in that she was waddling over Keyport. Later, a message reported cruising speed over Freehold and that brought all of the ground crew out so that the Shenandoah could be run into the hangar as quickly as possible.

Had the ship been delayed, another storm from the northwest would have driven her before its fury for several hours longer.

And it was radio alone that made possible the co-operation between ship and station that saved the Shenandoah from the ravages of the Northwester.

Lieutenant Nelson advanced the opinion that radio was largely responsible for the Shenandoah's escape from a greater disaster and possible destruction.

A thoroughgoing investigation was instigated without delay. The several constructional problems under consideration cannot be made public until official reports have been released. But the facts surrounding the inestimable service of radio throughout that night of anxiety was common knowledge long before the government could get the Shenandoah behind the tape-line for private observation.

And the responsibility for her safe conduct had been thrust upon the public quite unsolicited. Moreover, a rather unique situation was presented to the broadcast listeners. They had been aroused to active participation in an affair that had always been left to the management of supervisors indirectly appointed by them.

But a cry of distress from out of the

Upper portion of the Shenandoah's mooring mast with the nose of the ship clinging to the top after the dirigible had torn away

ether called upon the broacast listeners for active assistance. And it was through the same medium that aid was effected.

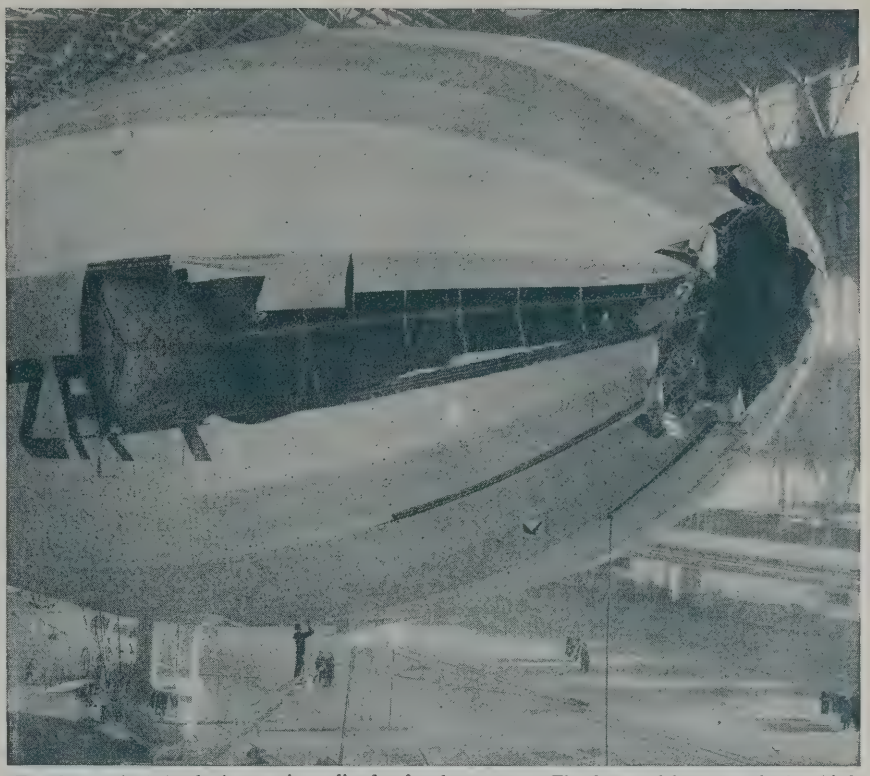
The relative importance of radio to airship navigation had been established.

In a contemplated North Pole flight, radio would serve as the only connecting link between the ship and the outside world.

Its practicability has been demonstrated in the Polar expeditions of Amundsen and MacMillan. In each case radio has served the dual purpose of maintaining an intimate contact with the outside world and a close inter-communication with scouting parties sent out to anticipate topographical difficulties.

An efficient radio compass has been erected at Lakehurst to direct the course of the Shenandoah on extended voyages. When the proper receiving equipment has been installed on the rigid airship, a trip to the North Pole would entail little more than accuracy in mathematics.

The stamina of the personnel and the element of danger in the unforeseen are matters that would naturally be subject to controversy. Lieutenant Nelson maintained that ignorance of aeronautics would very likely be the cause of most arguments that might arise over the contemplated Polar flight. But he entertained a lively conviction that the triumph of the Shenandoah in her valiant struggle against the seventy-mile gale, handicapped as she was at the outset, would prove her fitness to cope with a situation that could be calculated in advance and adequate measures adopted to insure her bon voyage.



The Shenandoah in the hangar immediately after her return. The damaged bow reveals the third section within, on the left, which was nearly damaged. Had that section been destroyed, the ship would have met with disaster

And it was notable that his optimism should find its inspiration in the splendid performance of radio during the most trying hours of the giant of the air.

The enthusiastic response of broadcast listeners had converted their passive concern in the mutual ownership of the great dirigible to an active sense of responsibility.

A pilgrimage of three thousand visitors daily for well over a week manifestly proclaimed the proprietary interest of the public in the Shenandoah and the toll of her wild ride throughout that memorable night. It was evident that they felt a sense of responsibility for her safe return.

The vast domain of broadcast listeners had become aware of a new era. They had, indeed, recognized their active participation in a world affair for the security of their firesides. And it was small wonder that they should view the Shenandoah somewhat more familiarly than was their wont in less personal affairs.

The new science of radio was that night dedicated to the service of aeronautics.

Make This Your Own Magazine

A magazine is a living, striving organism. It is composed of the many people whose ideas and writings appear within its covers

WE WANT YOU TO BE ONE OF US

Our great aim is to give the very best radio articles we can supply

If you know the very best thing in receivers and circuits: Write it down.

If you have a real inspiration and vision regarding the development of broadcasting: Write it down.

If you know a real, live radio story, with mystery or adventure or romance in it: Write it down.

If you can tell your fellow readers how to get the very most out of radio: Write it down.

If you know what is uppermost in the interest of millions of broadcast listeners: Write it down.

If you know, and know that you know, any angle of radio, thoroughly and accurately: Write it down.

Write it in good clear, forceful, non-technical English so all of your fellow readers can understand,

And send it to

The Wireless Age
326 Broadway, New York City

The Wireless Age will pay well for every article and story that rings so true and fills so great a need that we will want to give it to all of our readers in the pages of

The Wireless Age

The inimitable Irene Bordoni was bitten by the "radio bug" when she broadcast, from WEAF, a scene from her Broadway success, "Little Miss Bluebeard." The story of her DX adventures is told on page 30

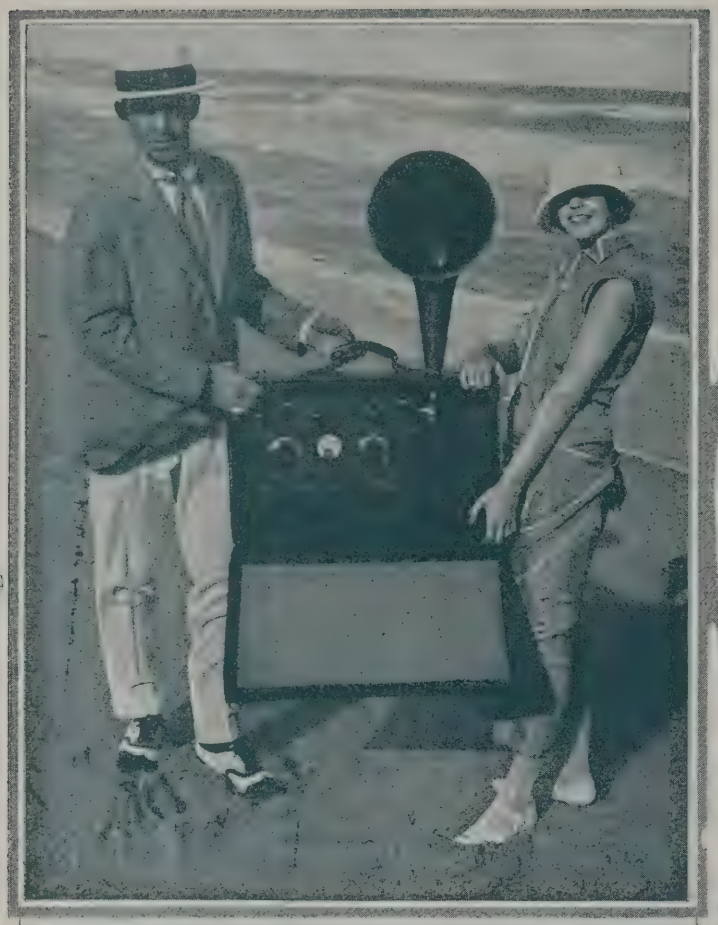
Broadcasting the Bok Peace Plan

General J. G. Harbord, one of the jury of seven which awarded the $100,000 Bok Peace Plan prize, spoke from WJZ on the ending of war

Edward W. Bok, a retired editor, broadcast from WEAF the winning award of his Peace Plan Contest

Mrs. Frank A. Vanderlip broadcast the Bok Peace Prize Plan from WGY. She also explained the referendum and encouraged all listeners to cast a ballot

A Radio Engineer's Honeymoon



Major and Mrs. Armstrong sojourning at the popular winter resorts with a portable radio set developed for reception without aerial or ground connection

Major Edwin H. Armstrong, one of the foremost radio engineers of the Radio Corporation of America, carrying his portable receiving set

The bridal couple, Major and Mrs. Armstrong, acquired many new friends on their happy cruise through the South. Their portable radio set caused a sensation and was credited with the honor of gaining for them a great many of their new acquaintances, but the couple hardly needed support in attracting friendships

Princeton Students Broadcast Musical Comedy

Sir Francis Drake as portrayed by "Wally" Smith

"Dinty" Dinsmore who played in "Drake's Dream"

Ted Russel, soubrette in play broadcast from WJZ

"Lord Ascot," was played by W. R. Brenton

Jack Barnsley in a Marconi Company uniform

Jack Barnsley Tells How He Reached the MacMillan Arctic Expedition by Radio

An Exclusive Story for THE WIRELESS AGE

Radio Breaks Arctic Silence

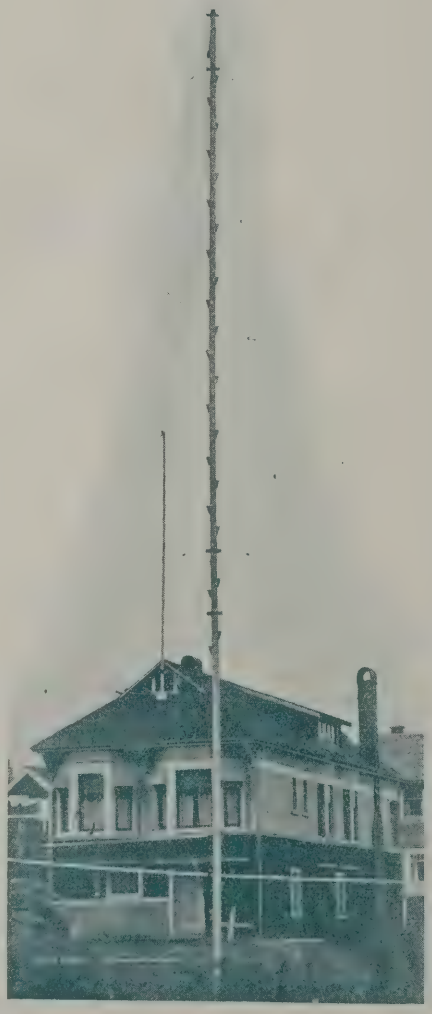
By Jack Barnsley

FROM the number of communications that have come to hand it would appear that what is foremost in the minds of many radio amateurs and others interested in radio, throughout the United States and Canada, is how Canadian Amateur Radio Station 9BP located at Prince Rupert, British Columbia, was able to get into radio communication with the MacMillan Arctic Expedition aboard their wireless-equipped, auxiliary schooner *Bowdoin*, for a period of about two months before any other radio stations were able to establish the connection.

Previous Arctic expeditions under Captain Donald MacMillan were not equipped with radio apparatus. Before the present expedition left, however, MacMillan was persuaded by his friend, Mr. E. F. McDonald, of Chicago, to equip his little 15-ton schooner, with radio apparatus.

The apparatus selected is of the latest design, such as used by many radio amateurs throughout the country, the power of the transmitter being 100 watts and of the continuous wave type, energy for this being obtained from large Delco storage batteries which are charged each day by a generator driven by a gasoline engine. Power from the storage battery is used to drive a motor-generator supplying alternating current of 500 cycles, which is again stepped up through a transformer to about 2,000 volts, this voltage being applied to the plates of two Western Electric 50-watt transmitting vacuum tubes.

The receiving apparatus consists of a Zenith regenerative tuner with audio-frequency amplification, together with a loud speaker, in order that the ship's crew may listen and enjoy the programs broadcast.



The aerial that caught the Bowdoin's signals. Canadian radio station 9BP

The antenna system during the voyage north consisted of a small aerial stretched between the masts of the schooner with a lead forward to the forecastle, where the wireless apparatus is located.

After it was decided to equip the *Bowdoin* with wireless apparatus, it was necessary to choose an operator. As the American Radio Relay League was in charge of all the arrangements with respect to the expedition's wireless, this was the prerogative of the League. Most radio enthusiasts would have welcomed the opportunity to accompany the expedition to the Far North in order to see for themselves what thrills the Arctic had in store for them, particularly from a radio viewpoint. Luck seemed to have been with Donald Mix, a first-class amateur with plenty of practical radio experience, residing in Bristol, Conn., who was finally chosen by the League to accompany the MacMillan Expedition as their representative.

The expedition which left Wiscasset, Maine, in the latter part of June, 1923, intended if possible to keep in communication with the outside world by the aid of amateur radio stations located in all parts of North America, many of these having prearranged schedules with the *Bowdoin* which they were evidently able to maintain until the expedition passed north of Disco Island, situated less than halfway up the West coast of Greenland toward Refuge Harbor.

As the expedition left from the Atlantic Coast, and their destination, North Greenland, seemed so terribly far east from the Pacific, it was thought by many wireless amateurs on the latter coast that the *Bowdoin* would establish communication with Atlantic Coast amateurs only, and it would only be under very favorable conditions that signals from the Arctic regions would be heard on the Pacific Coast. This presumption proved to be entirely incorrect, however, as instead of being heard occasionally on the Pacific Coast, the *Bowdoin* has been heard and worked almost consistently by the West Coast stations, while only a very few of the East Coast amateur stations have been able to even hear the faintest sound of the *Bowdoin's* signals.

Nothing having been heard from the *Bowdoin's* wireless for a long period after the expedition went north of Disco Island, it was feared by those closely connected with the success of the expedition's effort to keep in communication, that the arrangements as far as wireless communication was concerned were to be a failure. The Chicago Radio Laboratory, to increase the vigilance of amateurs all over the country, offered as a prize for the first amateur to establish communication a duplicate of the receiving apparatus aboard the *Bowdoin*. Although this kind offer was unknown to the writer, he was keenly interested in the expedition, and was fortunate enough to win the prize. Sitting at my receiver on the evening of September 5, I first heard WNP (Wireless North Pole), the call signal allotted by the United States Government to the *Bowdoin,* endeavoring to establish communication by transmitting a general call to all stations. An answer to this call was sent out from my station, 9BP, at Prince Rupert, but without result. Communication was not effected this night. Then again on September 7, the *Bowdoin's* wireless was heard. Knowing that nothing was impossible as regards the distance that signals from an amateur station may be heard under favorable conditions, a reply was again transmitted to the *Bowdoin*. Imagine the thrill and surprise when WNP replied with "Hello, old top, your signals very loud here. You are the first station I have been able to raise. Surely glad to get you." This was the first breaking of the *Bowdoin's* apparent silence.

The first night of communication was given up to a few personal messages from members of the expedition to their several families and friends, giving them the first news of their safe arrival in winter quarters at Refuge Harbour, North Greenland, located in latitude 78.30 north and longitude 72.30 west, where they are now frozen in solid until the ice breaks up during the coming summer. After the *Bowdoin* had transmitted all of the messages on hand, they were asked if they had heard the news of the terrible earthquake disaster in Japan, and on receiving a negative reply, particulars of the earthquake and damage sustained were dispatched, together with other world news, which Mix advised they were all glad to receive—not having had any news for quite some time. After this a schedule was arranged in order that regular communication might be maintained between the *Bowdoin* and the little amateur station at Prince Rupert.

The second night of communication was then taken up with a long press dispatch for the North American Newspaper Alliance, advising the outside world how the expedition was faring and what their plans were.

Since the first radio connection almost regular communication has been maintained by the Prince Rupert station and the *Bowdoin*, frozen in at Refuge Harbour, thereby giving the expedition means of communicating with the outside world.

After the ice formed around the schooner a new aerial was erected leading from the mast of the vessel to a cliff nearby. A counterpoise for the transmitter was also built. It consists of a number of wires leading from the ship and lying flat on the ice beneath the aerial. Contrary to the general manner of erecting counterpoises, theirs is not insulated from the ice, this being impossible due to the fact that much snow will fall before the winter is over.

The present quarters of the expedition are located ten miles north of Etah and within five miles of Explorer

The explorer himself, Dr. Donald MacMillan

Peary's base, from which, in 1909, he was able to discover the North Pole. Had his expedition been able to communicate by wireless, news of his success would have been received in America months before it was possible for them to return home.

According to messages received from Captain Donald MacMillan, it is very apparent that future expeditions under him will never enter the Northland without radio apparatus, as not only have they been able to receive the news of the world and messages from

(Left) The Bowdoin frozen in. Snow igloos are built over the hatches to protect against the cold which reaches 60° below zero
(Right) The crew of the Bowdoin, Dr. MacMillan third from left

Donald Mix, the radio operator on board the Bowdoin. His apparatus is keeping his mates in constant touch with the world

home, but their radio set has eliminated the great hardship of the Arctic—namely the solitude. They are able to sit in their electric-lighted cabin aboard ship and listen to concerts and church services from home.

The neighboring Eskimos, who visit the expedition on moonlight nights have been entertained by the ship's radio, but this great invention of man is so far beyond their imagination that they cannot comprehend it, and consequently they just regard it as another phenomenon. Not only have the Eskimos been entertained by broadcast music, but in addition the expedition has also a motion picture machine.

The Arctic night, according to MacMillan, is preferred by the native Eskimos, as during these long winter days without light they are able to enjoy trips with their dog sledges on the frozen sea ice, visiting friends and relatives in other parts of the country, while during the late Spring, Summer and early Fall the ice is either melting or gone, which makes travel by this means impossible. Summer is their time of work, when they are bound to gather together their supply of meat and eggs for the winter food supply. In addition to not having time to visit other settlements in the summer, travel by land is nearly impossible, and for that reason is seldom ever undertaken. Is it possible to imagine that at some future time, Eskimo igloos will be equipped with radio receivers and possibly transmitters, which will add to their happiness and contentment in the land of winters without light—so ideal for the reception of wireless signals?

Since regular communication was established in September by the Prince Rupert station, much news relative to the present welfare of the Eskimos has been given the world by Captain MacMillan. Messages of great importance relative to the magnetic and atmospheric observations being undertaken by the MacMillan party have been received from the *Bowdoin* for relay to the Department of Research in Terrestrial Magnetism, Washington, D. C. The receipt of these communications by radio is, according to the Department at Washington, unique in the history of this work. Reports from previous expeditions doing this work for Washington, on account of the lack of communication means, had to be held by the observers until the return to America of the several expeditions.

Over 15,000 words in actual messages have been handled between the *Bowdoin* and the Canadian amateur station, and the characteristic 500-cycle note of the *Bowdoin's* wireless is a welcome sound at the Prince Rupert station. At times the *Bowdoin's* signals are as loud as many amateur stations a few hundred miles distant, and at other times the signals are so faint that it is impossible to read them.

The Radio Department of the Bureau of Standards, Washington, D. C., have established voluntary stations for making observations of the wireless signals from the *Bowdoin,* and it is to be expected that much data will be gathered with which they will possibly be able to ascertain more accurately the cause of the fading signals with a view to discovering a remedy. They possibly will alone be able to say why the Prince Rupert station was the only connecting link with the *Bowdoin* out of the thousands of amateur stations located throughout the country.

The work in connection with the relaying of messages to and from the *Bowdoin* is beyond the imagination of the average person. Not only does it mean a nightly vigil awaiting the time when non-interference from other radio stations will permit the relaying of messages, but on account of the press dispatches from the *Bowdoin* bearing the name of the Prince Rupert station and being read by millions over the entire country, many who are interested in radio and the expedition as well as amateurs desirous to hear or get into communication with the vessel telegraph or write requesting some information in connection with the relay work or relative to the kind of apparatus used by the successful station, which needless to say entails much correspondence to make suitable replies.

For the information of readers a brief description of Canadian radio station 9BP follows:

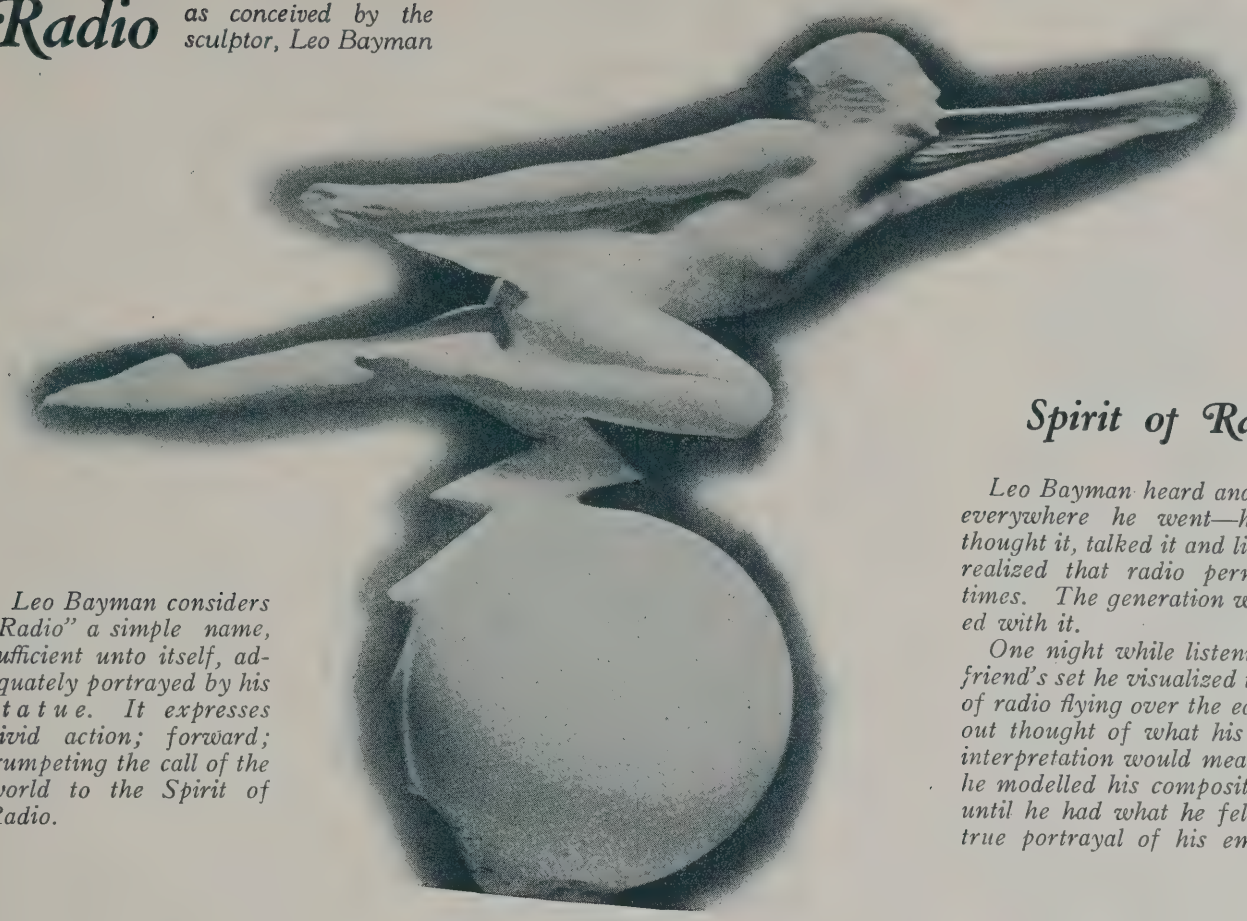
Antenna consists of a six-wire cage, 63 feet high, 75 feet top, with a cage lead-in 45 feet long. Counterpoise is 85 feet long, consisting of 12 wires spaced about two feet and being ten feet above ground. No ground connection is used with this counterpoise in connection with the transmitter.

The transmitter is of the continuous wave type and uses two fifty-watt Radiotron tubes in the reversed feed back circuit, using 1,500 volts of alternating current on the plates.

(*Continued on page* 88)

NOW the intrepid little ice-bound crew of the "Bowdoin" get a special program every night sent to them from WJAZ, Chicago, with news and personal messages; but until Jack Barnsley, in British Columbia, established communication by radio with Donald Mix, operator on the MacMillan ship, this brave group of men were lost to the world in the midst of the northern solitude and silence. In this story Jack Barnsley tells how he did it.

Radio *as conceived by the sculptor, Leo Bayman*



Leo Bayman considers "Radio" a simple name, sufficient unto itself, adequately portrayed by his statue. It expresses vivid action; forward; trumpeting the call of the world to the Spirit of Radio.

Spirit of Radio

Leo Bayman heard and saw radio everywhere he went—his friends thought it, talked it and lived it. He realized that radio permeated the times. The generation was saturated with it.

One night while listening-in on a friend's set he visualized the "spirit" of radio flying over the earth. Without thought of what his sculptured interpretation would mean to others he modelled his composition in clay until he had what he felt to be the true portrayal of his emotion.

I Am Radio—*By V. T. Miller*

I am Radio.
I am older than the rock of ages, yet I was born to man but yesterday.
I have been waiting for lo these many million moons for some one to bid me speak.
I came when light and air and water came to earth but all these countless years my tongue was tied.
I could not speak because no genius fashioned wood and wire in such a shape to catch my feeble whispers.
I have watched the world grow old and many times, if I could speak, I could have saved mankind its tears and disappointments.
Indeed, when Jesus came to earth, I knew and could have spread the news from far and near if some mere man had bent a wire into a coil for me.

I am Radio.
I know the ocean as you know home.
I know her storms and rocks and reefs and danger points.
I know and could have saved the countless hordes now buried in her cold, forbidding deep if God had told some one to build of wood and wire a tongue to speak the things I knew.

I am Radio.
What I could have done for man through all the ages gone I promise now to do for you.
My task from now will be to watch the ocean and warn the ships of every lurking danger.
To wrecks I'll send the rescue ships and while they come I'll cheer the crew with faith and hope and happy song.

I am Radio. I'll be up and at my task from morn till night and e'en till morn again.
Into the far corners of the earth I'll go.
When the hunter camps at night I'll be with him.
Into the land of midnight sun I'll go, and out of the cold, crisp air he will hear me sing sweet songs instead of the angry howl of hungry beasts.

My Name is Radio.
I'm not a freak seeking spectacular things to do.
I enter every home that bids me come and bring to it just plain old fashioned hope and cheer.
The farmer and his family listen in; I give him market news and weather forecast; I bring the city's band or concert to his home.
The isolation of the farm is gone; the link that binds it to the gathering place of men is me and I am free.
My name is Radio.

I am Radio.
Some call me fad and others say I'm but a passing fancy.
But I can sing and preach and teach a crowd of twenty thousand folks with perfect ease.
I can spread the voice of statesmen, poets, authors, from north to south and east to west across a continent, and, if need be, around the whole wide world.
I can sing the songs that stir the hearts of men like no one else can do.
These things I do and more, and do them free.
I am no fad.
I am Radio.

There's just one thing I make men do;
Each one must tune his set to mine if he would hear and understand.
To you who have no set I'll say that nature too can preach and teach and sing sweet songs if heart and mind are tuned to catch its meaning.
Out of the unknown, uncharted sky nature has been sending its hopeful, cheerful messages these countless ages gone to those "tuned in" to catch the voice of this great broadcasting station.
Think this over friend, and weigh it well.
My name is Radio.
I'm signing off.

Oh, It Is Too Much Radio!

According to Irene Bordoni

In an Interview By W. A. H.

Irene Bordoni

THE whirring of cup-tires on the wet pavement hummed in my ears as the blurred lights of lower Broadway sped by the taxi windows.

Irene Bordoni—the inimitable Irene—pouted.

Her manager idly speculated on the whereabouts of the dim figures glimpsed through the drizzle as they scurried along the nearly deserted streets. Actually, his troubled conscience sought surcease from temperament.

"Mlle. Bordoni," I coaxed, "why do you say that radio is *désagréable?*"

Her large eyes peered through the fur collar of her coat. Those eyes were baffling.

"I go to broadcast my act," she answered, "I get no pay; I have not my dinner; my dinner—he is so important; I am tired and I must be at the theater by seven."

But arrived at the studio, the warmth and comfortable luxury seemed to awaken some interest in her surroundings. Pointing at various instruments she repeatedly asked, "What's that thing?"

Mr. Warburton Gamble and Mr. Stanley Logan, the other two corners of the "triangle," had arrived earlier and were engaged in their preliminary try-out on the microphone. Miss Bordoni was delighted with that.

Turning to her manager she exclaimed, "I came down here to please you—now you would like to please me—yes?"

The man looked trapped, but he nodded affirmatively.

"This radio thing—I like him," she confided, "so we must make the scene longer."

And that in itself was encouraging because she had originally protested, and had devised ways by which the scene could be logically cut down.

Colette (Irene Bordoni) had been married to Bob Talmadge (Mr. Logan) but Bob had a lawfully wedded wife, back home, who might object so he blandly used the name of his friend, Larry Charters (Mr. Gamble).

Immediately following the ceremony Bob regretted his hasty act and at a loss as to what procedure was best under the circumstances finally decided to take Colette to his friend, Larry, whose name he had so outrageously exploited.

The characters went on the air at the point where Colette finds herself in the presence of the two men, her husbands—one in fact, one in name.

And who else than Irene Bordoni could untangle the complications of such a plot?

She concluded the performance before the microphone with a song hit, "So This Is Love."

This extract from "Little Miss Bluebeard," her Broadway success, had been done for the unseen radio audience with the master touch of the scintillating, spirited artiste. It was truly Irene!

Her reluctance at leaving the studio was evident. A few days later she had a small "headset" radio in her dressing room at the theater. But the phones hurt her ears.

Urged to buy a large set with a loud speaker, she protested, *"Merci*—I do not like the bug—I just tune a little!"

But her husband, E. Ray Goetz, would be in Palm Beach with Irving Berlin over the holidays and since they were broadcasting there, Miss Bordoni wanted to hear her husband's voice. Ever thrifty, she justified the expense of a large receiving set by deciding it would be his Christmas present.

So I to see her set.

On East Seventy-eighth street, just off Madison Avenue, Irene Bordoni's home stands between sky-scraper apartment dwellings.

Within, simple artistry distinguishes the color scheme of blue and the atmosphere was distinctly homelike.

Seated before her radio, intent, Miss Bordoni was visibly agitated over the

Mlle. Bordoni operating her radio at home

squealing and howling that emanated from the loud speaker.

"I try to get the Edgewater Beach Hotel in Chicago," she complained, "and look what I get—Swift and Company—Oh, it is too much radio."

"Why not listen for your husband, Mlle. Bordoni?" I asked.

Her round eyes studied me contemplatively.

"I get home from the theater at midnight," she explained, "and tune the radio thing but I cannot hear my husband."

She tried to tell me what stations she had heard, but the call letters invariably got tangled beyond recognition.

"I spent much money for this," she continued, "and all I hear is sometimes — weather reports — bed-time stories—sometimes jazz.

"But the baseball thing—the football thing—the President Coolidge thing—oh, that is so good, but oh-la-la, how good I would make it—this radio broadcast!"

I asked her what she would make it.

"The broadcast!" she exclaimed. "I make it like vaudeville—music ten minute—not so many pieces in one time—maybe one little play for twenty minute—and like that—many variety, but short."

Miss Bordoni had an excellent plan for broadcast programs so we covered the subject quite thoroughly.

She acknowledged that there were certain features, desired by a great many people, that could never be reconciled with vaudeville.

She maintained that market and weather reports should be broadcast from one station on a definite wavelength so the business man could have a set installed in his office that could be operated by pushing a button. The same station could likewise serve the farmer in the evening.

Lectures should be handled on a set wavelength from a station equipped for that purpose. In such manner people could subscribe to lecture courses just as they now do at the Town Hall in New York and at Chautauqua meetings in the rural districts.

Education, she thought, could be developed to the highest standard obtainable by the agency of radio, and that its proper handling would automatically gravitate to the "lecture-class" stations.

She was more reluctant, however, in granting that there would always be a large audience to demand jazz music. It seemed to her that jazz and classics could be adequately injected into the vaudeville programs. She was convinced that radio must ultimately develop in people a sensitive ear for music, which, of itself, must lead to an even more critical appreciation of the finer compositions. By way of illustrating her point she indicated the success of Grand Opera houses in the Ghetto, patronized by a people, abject and poverty stricken, but none the less hungry for the best in music.

Miss Bordoni agreed that Grand Opera should be broadcast, but individually and at regular intervals if a daily schedule were not feasible.

Her idea about radio plays was somewhat vague. She believed that any play, to be successful, would necessarily entail an organization of rather wide scope, and quite naturally defended the position of high salaried artists. But she felt equally certain that a play, to be broadcast must depart from the accepted structure for plots as we now understand them. Consequently, the recognized artist would be of less value than the play itself. And of course the supporting cast, theater personnel, corps of lyric writers and directors and the publicity staff would dwindle to studio proportions.

It was finally decided that the future of radio plays should be the handiwork of the muses.

As I was departing it occurred to me that she might have done something interesting with her "dressing-room" set.

"Oh, that!" she laughed. "I gave that to my manager."

"Well, what in the world did he do with it?" I queried.

"He is real bug," she confided, "he hide the radio in his desk. Every day he lock the door and tune a little—that is when his secretary say he is out!"

A tense, dramatic moment in the scene from "Little Miss Bluebeard" broadcast from WEAF. Irene Bordoni, as Colette, and Mr. Logan as Bob Talmadge.

Movement to Reduce Interference

AT a recent conference in New York, representatives of the radio manufacturers and publishers decided to make an effort to eliminate radio interference from objectionable receiving sets. Their plan is two-fold: First, they propose to urge all manufacturers to put out only non-radiating sets, being willing to aid in the designing of such sets; and, secondly, to inform the radio fans how to remodel or improve existing sets so that they do not cause interference among the receiving fans within a radius of some ten miles, as is now frequently the case.

Two committees were appointed; one technical, to handle designs and improvements, the other to distribute and make public operating instruction, data, and diagrams for improving regenerative sets. Prof. Hazeltine of Stevens was selected as chairman of the first committee and Stephen Coles as chairman of the publicity committee. The conference decided to recommend no particular type of receiving set, but to conduct an educational campaign. The desirability of non-radiating sets will be made clear, as an important move in reducing interference.

Major Armstrong, inventor of the regenerative hook-up, was present and entered into the discussion offering many suggestions, among them his plan to add a stage of radio frequency as a "muffler."

Chief Radio Supervisor W. D. Terrill, who was in New York in connection with departmental matters, attended and was selected as presiding chairman.

A Radio Operator Sees the World
in his own way

Operating is a sure path into a Radio Career

By W. S. Fitzpatrick

"MAKE your subject 'Radio Operating As a Career,' showing its possibilities and pit-falls; tell of the bright side with all the encouragement due the profession, but also speak frankly of the hard knocks and the discouragements; give the young fellows the information they need to enter the field; tell the parents what they should know about their boys traveling on ships; give the boys themselves some tips, and show how radio operating is a profitable calling, both in itself and as a stepping-stone to the more highly remunerative positions which radio affords."

Such were the instructions that accompanied the request of the editor of THE WIRELESS AGE to contribute one of the series of articles on "The Opportunities in Radio Today."

Our first analysis must necessarily attempt to discover whether radio operating is an inviting and profitable career for a young man to choose. As though there should be any doubt of it! The doubt that does exist, it is safe to say, is only in the minds of operators who have not made good and those with whom such operators have come in contact.

As with other branches of the radio game, operating holds out great possibilities for young men—or even the older ones—who really apply themselves the same as would be necessary to succeed in any other line of endeavor.

For those who use it merely as an opportunity to see the world or as a means of entering the radio field with the expectation that the prestige gained thereby will immediately land a post of district sales manager of a large radio house with an attractive salary, radio operating does not hold the same advantages.

Fellows of that kind are not interested at heart. They may be conscientious and really try to comply with all the written and unwritten regulations, but somehow or other they do not get anywhere. They become dissatisfied and begin complaining that "there's nothing in it; you can't get any thing out of it; there's no future to it."

A typical example is the fellow who becomes fascinated with radio through his or a friend's possession of a receiving set, by means of which he has learned the code, or perhaps through an operator friend who sent him post-card views of interesting and unusual scenes. He enters with the expectation that the same fascination will continue. There's nothing for him to do or think of except send messages for pretty girl passengers, receive important stock fluctuation dispatches for prominent business men and bankers aboard, spend his idle moments listening to concerts in distant cities at a distinct advantage over his friends ashore; then upon reaching a foreign shore, strut along, (mayhap in full uniform) watching the populace stop and adoringly nod and remark to each other: "He's the radio operator on that big ship that just entered port."

An observing eye watching radio activities over a period of fifteen years has noted the various types. It has noticed that this particular type has dropped out of radio at steady intervals, each with the same expression: "There's no future in radio."

A conservative estimate, based on available information, shows that approximately eighty-seven per cent. of the radio operators who left the game within the past fifteen years are not as well off in position, as well off financially or as well off in future prospects as they would be, had they remained as radio operators.

During the past fifteen years many have entered and left, but a large number have stayed. The general managers of such companies as the Radio Corporation of America, Tropical Radio Company, Marconi Wireless Telegraph Company of Canada, and the Ship Owners Radio Service, entered as radio operators within the past fifteen years.

The assistant treasurer, sales manager, advertising and publicity manager, practically all the superintendents and district managers as well as many of the force of the sales and traffic departments of the Radio Corporation were radio operators within the past few years.

The general manager of the Independent Wireless Telegraph Company was also an operator, but quite early became an official. Practically all the officials of that company were operators a short time ago.

The radio operator on board ship tours the world and accumulates interesting experiences and memories of quaint and wonderful scenes. His responsibility is great when his ship ploughs through storm swept seas. At other times he can enjoy the quiet port and the spell of the Orient

Thus we speak of the past fifteen years during which time radio made slow progress. What is going to happen during the next fifteen years with new departures coming to the fore every day? Can't you see opportunities galore?

Awaiting development is the static eliminator, the interference preventor, the concentrated tube transmitter, an ultra-sensitive detector! Is some operator, thinking things out during his spare time at sea, going to furnish the ideas? Maybe!

Of course, it is not meant to infer that a young fellow should choose radio as a career so that he can invent some new idea. But then, where is there an industry that offers more opportunities for the adoption of new ideas? In every industry isn't it usually the man actually using the apparatus that makes the suggestion for improvement, and almost always receiving a substantial financial reward?

There are very few, however, who would choose a line of work simply because there are opportunities of gain through stumbling across new ideas. Of the thousands of operators in the past very few have made extraordinary development. As a matter of fact they are prohibited from using any part of their apparatus for experimental purposes and are also prohibited from bringing any of their own apparatus along on ships with them. Mostly all radio development has been made by research men—generally ex-operators—who devote their entire time to experimenting.

Among the opportunities of radio operating and well to the fore comes that of "seeing the world." The commercial radio operator does not merely see it "through a port hole." If he can't get shore leave his cabin is located where he can at least get a view and he has the freedom of the decks; even the bridge and other advantageous points are not denied an operator in the good graces of the captain and officers.

"Seeing the world" seems to have a different aspect to every one you meet. One sees art, another sees history, another is interested only in the customs of the people, and a number, it is unfortunate to have to admit, look only for the "pubs."

The operator in the service of a radio company having a large variety of vessels, can really see the world and see it in his own way. There are three large radio companies in America who have vessels running to all parts of the world. Their operators have an advantage of being able to transfer from one run to another while the men on ships where the owners manage their own radio see only the one or two ports at which their vessels touch.

Frank E. Golder, of Joplin, Mo., who quite recently returned from an extended voyage on the steamer *Selma City,* furnishes an excellent example of the sight-seeing advantages afforded radio operators. It was he who made our illustrations possible through his kindness in giving the photographs from among his collection of hundreds. He is one of the men who derive pleasure and profit through traveling.

* * *

Meeting and talking with different people throughout the world broadens any man's education, even without his seeking. Operators who run regularly to a particular foreign country have an advantage of learning the language of the country that cannot be offered by a school. A new language makes a new man.

Every ship operator knows the charm of the East

The problem of a career comes to the mind of every young man. Some turn to banking as their chosen work; some start as salesmen in retail lines; others like maufacturing; many choose railroading, and a number enter radio. In their respective vocations each man looks for advancement.

Pass over ten years and compare the status of the different men. A few of the bankers will be found to have risen to tellers and probably cashiers and on the road to presidencies. Some of the salesmen have become managers or owners. Certain of the manufacturers and railroaders have become superintendents or vice-presidents. Just as large a proportion of the radio men have risen to executive positions or something as good. The majority in each line, however, will still be bank clerks, salesmen, factory hands, railroad workers or radio operators. Let us make a comparison within this large group.

The radio operator's total income during the ten-year period will be found to compare very favorably with that of the average men who entered the other lines. He can show an advantage over the others who have remained in one place in so far as he has seen other lands and perhaps has learned other languages. He may have applied his spare time in studying other lines of business.

The salary of the average young man ashore does not run much over $130 per month. There are numerous radio operators who receive that much and many who receive more and it costs them nothing for board or room. The man ashore receiving $130 pays out half that amount in living expenses. Even at $105 per month, the average operator's salary, the net in-

(*Continued on page* 86)

COLPITTS' Push-Pull Circuit Kills Distortion

Much Distortion comes from forcing your tubes. In the Push-Pull Circuit two tubes are balanced to counteract oscillation of tubes.

By
Samuel C. Miller
Member, Institute of Radio Engineers

IN the early days of radio broadcasting the radio listener was principally interested to obtain the maximum amplification possible. Radio fans in some cases would go to extremes to obtain this high amplification by using an unlimited number of tubes in combination with a loud speaker that gave the most noise. Good quality did not enter in, as noise was the predominant factor.

But gradually, as the broadcast stations began to eliminate the various distortions from the transmitting equipment, the radio fan began to realize the fact that his receiving equipment required an overhauling in order to make it reproduce what is actually being transmitted. Even dyed-in-the-wool radio fans became fairly well saturated with the ungodly howls that represented speech or music. Prospective buyers of radio receivers would go away very much disappointed after listening to a demonstration at a friend's home or at the local dealer with his eight-tube howler going at full blast so that it could be heard two blocks away. This condition put the radio art in a very precarious position and it only lately, due to the untiring labors of various investigators, that the causes for distortion are being overcome so that the most discriminate may listen and not complain regarding quality. The results of these investigations have appeared in periodicals, newspapers and other mediums, giving the amateur valuable instruction in methods of improving the quality of his receiver.

Radio broadcasting has jumped by leaps and bounds in popularity because it is now possible to obtain from the receiver system a very good reproduction of what is going into the microphone at the transmitting station. Although the major distortions have been eliminated, experimentation is far from completed. Researches are being continually conducted toward the point where the reproduction is perfect.

Distortion in a receiving set can be caused in many ways. It may be due directly to the apparatus used or it may be traced to the electrical design of the set. The following are some of the major causes for distortion:

1—Tube characteristics
2—Regeneration
3—Audio frequency transformers
4—Loud speaker
5—Tube overloading

Tube Characteristics

The working portion on the characteristic curve of the vacuum tube is almost a straight line. (A-B in figure 2.) This is true of the standard amplifier tubes on the market, but does not hold for the soft detector tube with its gaseous contents. Distortion can be eliminated in this case by using only the hard or highly evacuated tubes of the UV-201A or C-301A types even in the detector step. The amount of volume that is lost by using a hard amplifier tube in the detector step instead of the UV-200 type is compensated for in quality.

When using a tube as an amplifier, it is necessary to use the proper negative bias on the grid for distortionless amplification. The value of grid bias depends on the plate voltage and the relation between the two are, in standard tubes, as follows:

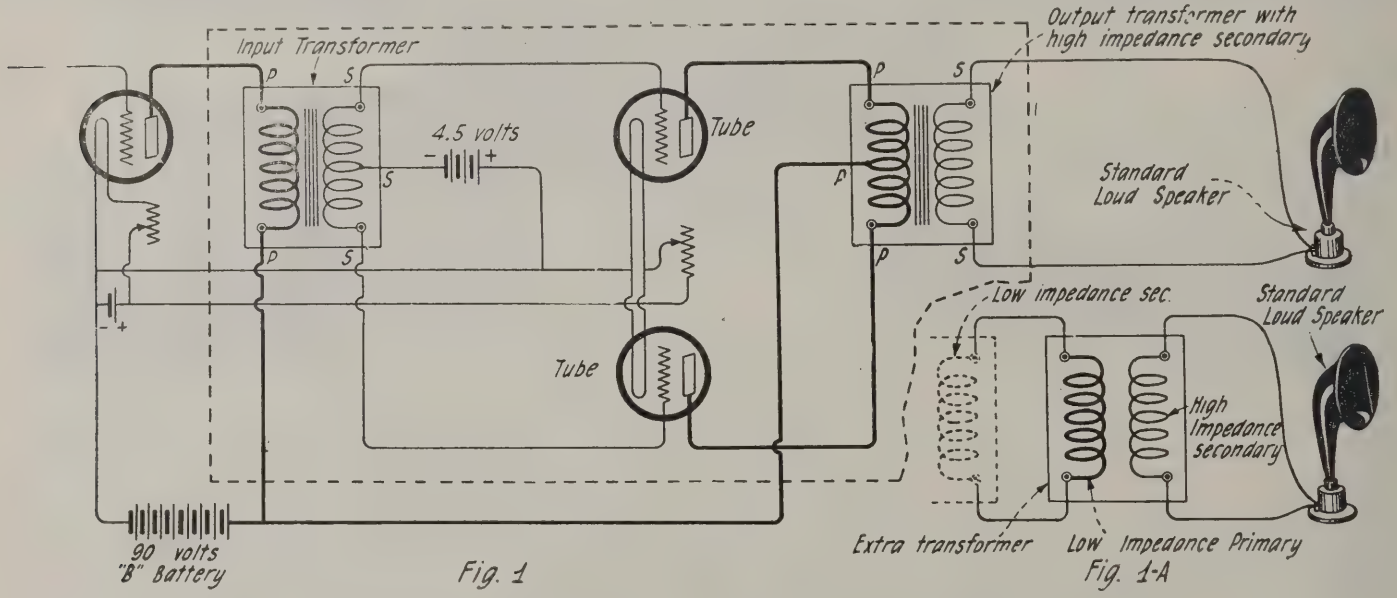


Fig. 1 Fig. 1-A

Push-pull circuit connected to a high impedance loud speaker from the secondary winding of high impedance

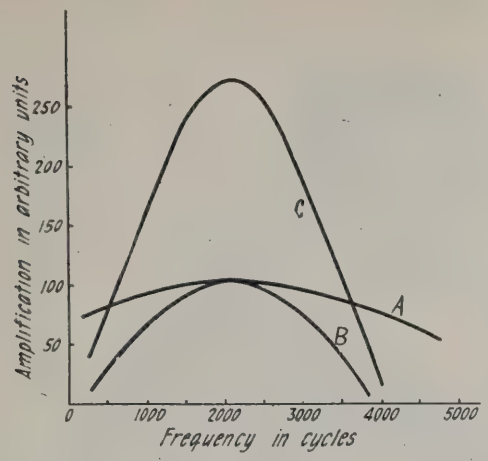


Fig. 2

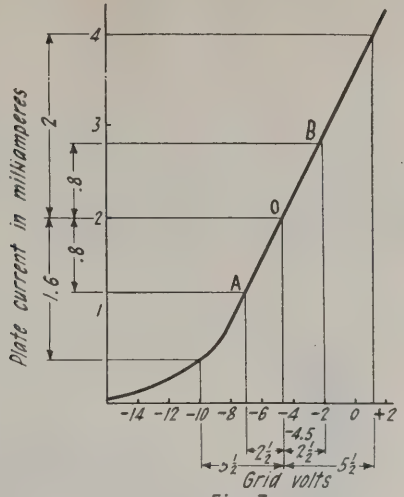


Fig. 3

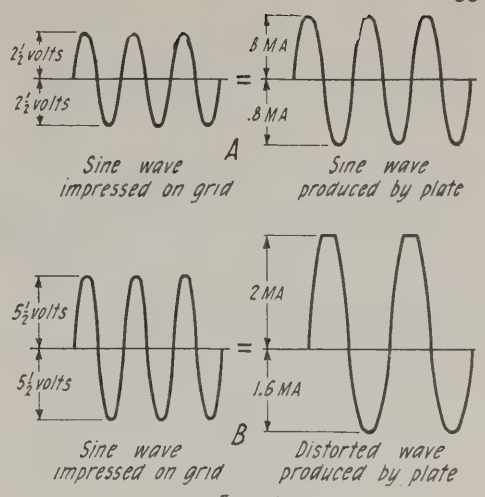


Fig. 4

Distortion characteristics of poor transformers

For 22 volts on plate use 0 volts on grid
For 45 volts on plate use 1½ volts on grid
For 67 volts on plate use 3 volts on grid
For 90 volts on plate use 4½ volts on grid

REGENERATION

Another cause of distortion can be traced to the inefficient handling of the controls on the receiver. The adjustment should never be set near the point of maximum regeneration for a given signal. The higher the gain in signal intensity by regeneration, the more chance there is of distorting the signal even though there may be no oscillations audible to the ear. Nevertheless, the set may be oscillating at a higher frequency than it is possible to hear and thus spoiling the quality. It is therefore always advisable to use only enough regeneration to give a good signal.

AUDIO FREQUENCY TRANSFORMERS

Good quality as understood by engineers means transmitting and receiving with equal intensity the band of frequencies between 25 and 10,000 cycles. Accordingly, the audio frequency transformer, if improperly designed, may be the serious defect in the receiver, causing distortion. A good transformer should, within physical possibilities, amplify with equal intensity the band of frequencies above, as indicated by A in figure 2. A poor transformer will have a curve as shown by B in figure 2 where the low frequencies and the high frequencies are amplified considerably less than certain frequencies between. The cause for loss of the lower frequencies in a transformer is due to insufficient inductance in the primary winding. The loss of the high frequencies is due to the leakage and capacity between windings of the primary. In a correctly designed transformer, the primary inductance is made high enough to give an impedance equal to the tube impedance at 100 cycles. This value is approximately 25 to 30 henries. The leakage and distributed capacity is kept at a minimum by the use of pancake windings and proper insulation between layers.

Distortion due to poor transformers becomes very serious when more than one stage of amplification is used. At the end of the second stage of amplification the curve "A" of figure 2 would be changed to curve "C," figure 2. The second transformer in the amplifier causes a further decrease in the lower and higher frequencies because it receives from the first transformer a signal already greatly lacking in the lower and higher frequencies. It is very imperative when purchasing audio frequency transformers to get only those which have data regarding their performance when plotted against frequency.

LOUD SPEAKERS

The writer in his contact with various radio fans and their respective sets has found that more sets are spoiled by poor loud speakers than any component part of the equipment. This applies especially to those reproducers consisting of ordinary earphone receivers used in combination with a tin

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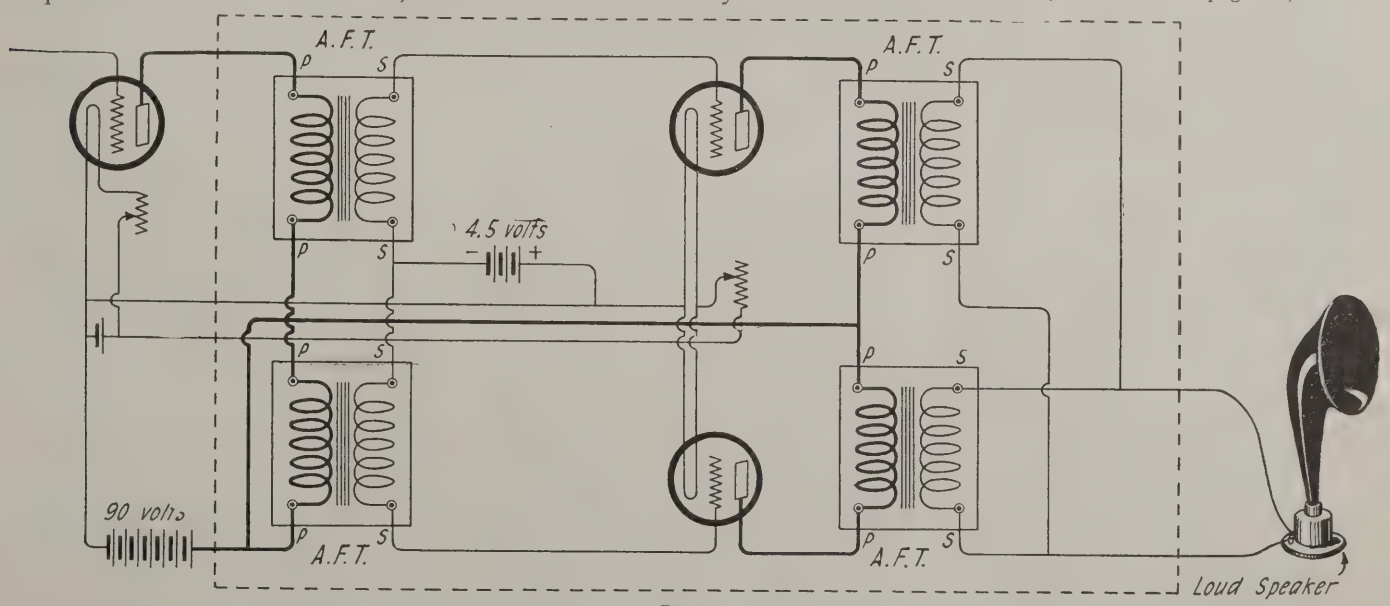
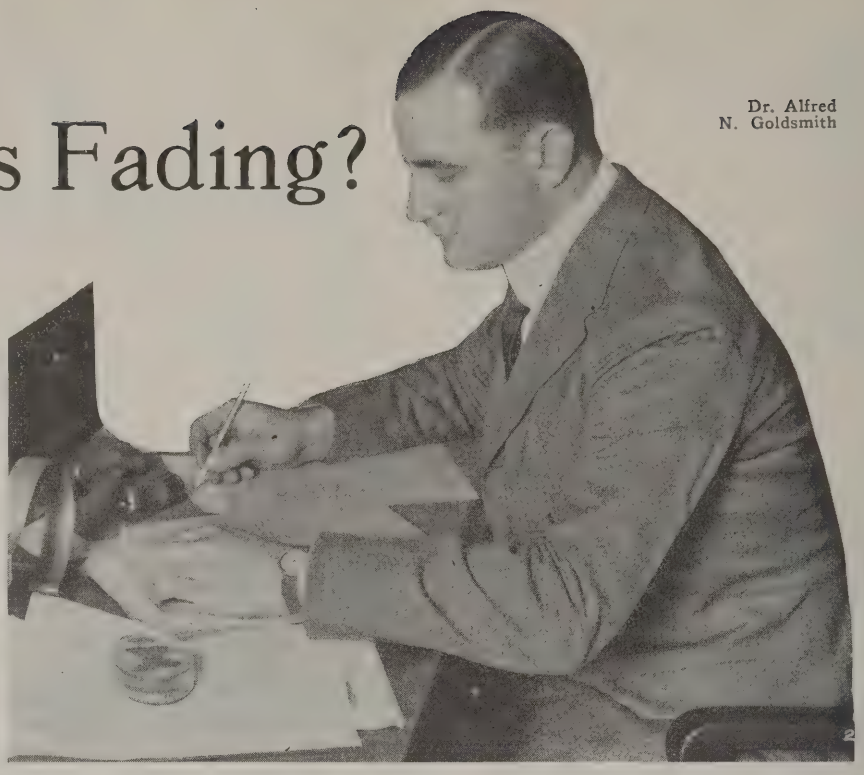


Fig. 5

Push-pull circuit diagram using standard audio frequency transformers

What Causes Fading?



Dr. Alfred N. Goldsmith

Enormous Mirror in Upper Atmosphere Responsible for Long Distance Reception. Ground and Sky Waves May Combine to Cause Fading Effects

By Alfred N. Goldsmith
B.S., Ph.D., Fellow I.R.E.
Director of Research, Radio Corporation of America

VERY peculiar things happen sometimes in the receiving of broadcast radio concerts. Every listener, as soon as he gets acquainted with a number of nearby and distant stations, finds that he is puzzled by some of the results he gets. How shall he explain such things as these:

1. Late at night he can hear stations hundreds of miles away clearly, while earlier in the evening, or by day, he can hardly hear fifty miles.

2. He will hear some stations at night very steadily, and particularly the distant ones, but some other nearer stations will "fade" in and out rapidly and in irregular fashion.

3. Still nearer stations, say twenty-five miles away, will not fade in or out at night or by day.

4. In one part of a city, Station A in that city will be heard loudly and Station B in that city hardly at all. In another part of the same city, the reverse will be the case. Outside the city both stations will be about equally loud.

5. A listener in the country will sometimes hear stations hundreds of miles away much better than he will hear stations in a nearby city, say fifty miles away.

Radio engineers have a theory to explain these effects. It can be simply expressed, but it should be remembered that it is not a positively proven theory, but only a very plausible and satisfying explanation of all the puzzling effects just mentioned. It is based on a theory of Sir Oliver Heaviside, the eminent English electrician and mathematician. Heaviside pointed out that, twenty-five or fifty miles up, the air enveloping the earth becomes very rare and is therefore an electrical conductor just as is the rarefied "violet ray" tubes sold for medical purposes. So that, far up in the sky, there is a layer of conducting air which scientists have called the Heaviside layer. It is also well-known that substances which conduct electricity, such as metals, are good reflectors for radio waves, so that this layer is actually a sort of curved reflector in the sky. It is therefore called the "mirror layer" in this description, for the sake of simplicity.

By day, the mirror layer is spoiled in several ways. In the first place, the brilliant sunlight falling on it causes disturbing air currents and irregularities, so that instead of being a smooth and polished mirror, it becomes a roughened irregular layer of little use as a reflector. Furthermore, sunlight has the property of converting rarefied air into a sort of "fog" which, while clear and transparent to ordinary light, does absorb radio waves vigorously. By day, the mirror layer is rough and mist-covered.

Probably most listeners have never speculated as to whether the radio waves which reach their receiving aerial come sweeping along the ground or whether they are shot down to the aerial wires after reflection from a mirror layer in the sky. Yet actually radio waves arrive by either or both of these dissimilar routes.

In the illustration of this article, part 1 is a general sketch of a sky wave. It leaves the radio transmitting station at the left, passes obliquely up until it strikes the mirror layer far up in the air, and is then reflected back again to the earth, arriving finally at the receiving station to the right. It may be mentioned that these sky waves do not die down very rapidly because their path is entirely through the air and they are but little absorbed or interfered with in their message. So that we should expect sky waves to carry radio messages loudly over great distances, particularly at night when the mirror layer is smoothest and most effective, and when the absorption of the radio waves by the "electrical fog" caused by sunlight is absent.

Part 2 of the illustration is the other sort of wave which may reach a receiving station. It is a ground wave, and clings closely to the earth. Naturally such a ground wave encounters all sorts of energy-absorbing obstacles in its path, which rapidly reduces its power and the loudness of the signals it can produce in the receiver. Such objectionable obstacles are steel-structured buildings, mountains—particularly those containing metal deposits—and to a less extent forests of large trees. The result is that a ground wave rapidly dies away, and this has been indicated in the diagram.

To take typical figures, which are very roughly correct for an average broadcasting station in the eastern portion of the United States, the ground waves are very strong near the transmitting station for the first few miles and rapidly die down, becoming relatively quite weak at a distance of a hundred miles or so. The sky waves, on the other hand, are hardly received at all near the transmitting station since their path is above the earth until after they have been reflected back to the ground. They come back to the ground and begin to be useful at distances of about seventy-five miles from the transmit-

ting station, and beyond that distance they are readily received with good intensity for distances of several hundred miles. It amounts to this, to summarize: for distances up to about seventy-five miles, the listener is depending almost entirely on the ground waves for his signal. From seventy-five miles to about two hundred miles, he gets both ground waves and sky waves. Beyond two hundred miles, most of his reception is dependent on the sky waves.

For locations where both sky waves and ground waves are received, reception may become very erratic with marked "fading effects." Part 3 of the illustration shows how this may come about. The two sets of waves, arriving at the receiving station by different paths, may help each other or they may actually annul each other. Furthermore, as the mirror layer shifts slightly from moment to moment, the ground waves may sometimes weaken or annul the sky waves, and thus cause fading. We can therefore explain the five puzzling effects mentioned at the beginning of the article as follows:

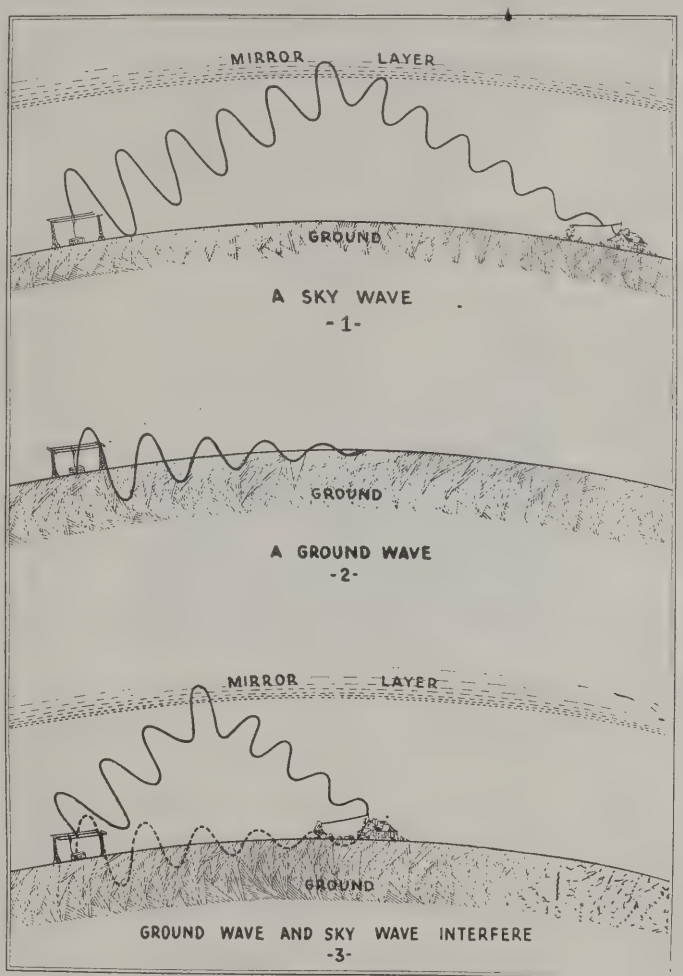
1. Night reception over long distances is accomplished by the slightly absorbed sky waves, and these cannot exist by day because of the absence of a smooth mirror layer and the disturbing presence of sunlight "fog." So that day reception is by ground waves, which do not reach out powerfully nearly as far as sky waves. This partly explains the superiority of night reception.

2. Night reception from very distant stations is by means of the sky waves only, and is therefore comparatively steady. Night reception from stations roughly from seventy-five to two hundred miles away is by a combination of sky waves and ground waves, and therefore fades in and out as these two sorts of waves interfere with each other.

3. Reception from stations nearer than seventy-five miles is chiefly by ground waves only, and is therefore reasonably steady.

4. Reception in a city from nearby stations is by ground waves, which are very badly absorbed by the steel structures of the city. A mile or two of city buildings will so weaken the signals from a city station, as received by a city listener, that reception may become very poor. As a result, in those parts of the city where the signals have first to plow through miles of steel to reach the listener, reception from that station will be poor. In other parts of the city the reception will be excellent. Far outside the city reception will be by the sky waves and about equally good from all comparable stations within the city.

5. A listener in the country will get signals from the city fifty miles away almost entirely on weak ground waves, but will get distant signals on the powerful sky waves. Thus the distant signals are sometimes astonishingly loud in comparison with the nearby signals.



Action of reflected waves and ground waves

It adds another chapter to the romance of radio to know that the concerts from distant cities have traveled up to the sky on their way to the broadcast listeners, and that an enormous mirror in the upper layers of the earth's atmosphere is chiefly responsible for the enjoyment of distant concerts.

Supplementing Dr. Goldsmith's clear explanation of the probable causes for fading we are able to add corroboration of his explanation by another engineer, Roger H. Bryant, radio engineer with the Westinghouse Electric and Manufacturing Company, who gives his explanation in the following words.—[Editor].

MANY of us have experienced a feeling of great disgust when listening to a good concert from a broadcasting station to have the music gradually die out. Frequently the regularity with which the signals die out at the crucial point leads one to think that something has control of this phenomenon.

The periodical dying out of radio signals is known as fading. There have been many attempts to make measurements on radio transmissions to determine the exact cause of fading but few of these measurements have produced any worth-while data. The best explanation of fading seems to be a theoretical one. It is believed that at a height of thirty or forty miles above the surface of the earth that the air becomes so rarified that it becomes a conductor of electricity. As such it acts like a reflector of the electromagnetic waves by which radio communication is effected. The result is that the waves reach the receiving antenna not by one definite path but by a number of paths of different length. The diagram will make this clear.

A radio transmitting station sends out electromagnetic waves which radiate in all directions. Some of them go directly to the receiving station, while others go by an indirect route up to the conducting layer and then down again. If the difference in length of these two paths is right, that is, a multiple of the wavelength, the waves will add and the effect produced will be greater than by the direct transmission alone. But the difference in length may also be such that the waves do not add and thus the effect may be less than it would be by direct transmission. The reflecting layer is constantly shifting so that the reflection varies momentarily between the limits described, resulting in varying intensity of the signal received. Thus the fading.

This simple explanation of fading leads to several interesting things. The reflecting layer is very indefinite during the day. Hence there is less fading during the day and this seems to be the case. On account of the lack of reflection, the range of a station is much less during the day than at night and this we all know to be the case. It would also appear that it is impossible to send radio signals away from the earth.

Scientific study of the upper atmospheric strata going on at present will undoubtedly shed new light on electromagnetic wave phenomena.

Design of Loop Antenna

PART II
Construction

By Ralph Batcher, E.E.
Author: "Prepared Radio Measurements" Wireless Press

(Part I of this article covering the theoretical design of Loop Antennas appeared in the February issue)

MANY claims are made by the sponsors of various styles of loops, when disclosing the value of their particular designs. The superiority of any particular type or shape is generally without much of a theoretical basis, and it is very likely that any unusual results obtained are due to the builder striking the right values for use on his own particular receiver.

It will be shown that two loops having the same number of turns and the same average area per turn, theoretically pick up the same amount of radio energy, regardless of whether the turns are round or square or have any other special shape. A square loop has the same effect whether mounted with edges oblique (Figure 1) or vertical and horizontal as in (figure 2).

The actual style is then a matter of personal taste only. Since the charts given in Chapter I of this article gave the inductance of square loops only, and since loops built in any other style generally require greater mechanical skill in designing the supporting rods, this style only will be taken up in detail. It is evident that a circular loop should give the greatest inductance with the least amount of wire, but this type is difficult to construct unless very stiff wire is used.

In nearly every case it is found that the feature of being able to rotate a loop about a vertical axis, to make use of its directional features, is well worth the extra constructional work necessary to produce it. In some places in a city where there are steel buildings near or over the loop it is advantageous to be able to rotate the loop also about a horizontal axis as well, but the gain in signal strength resulting from this is rarely worth the extra cost and work involved, so that its use is not recommended.

The favorable feature in the types shown in figures 1a and 2a rests in the economy of work involved in their

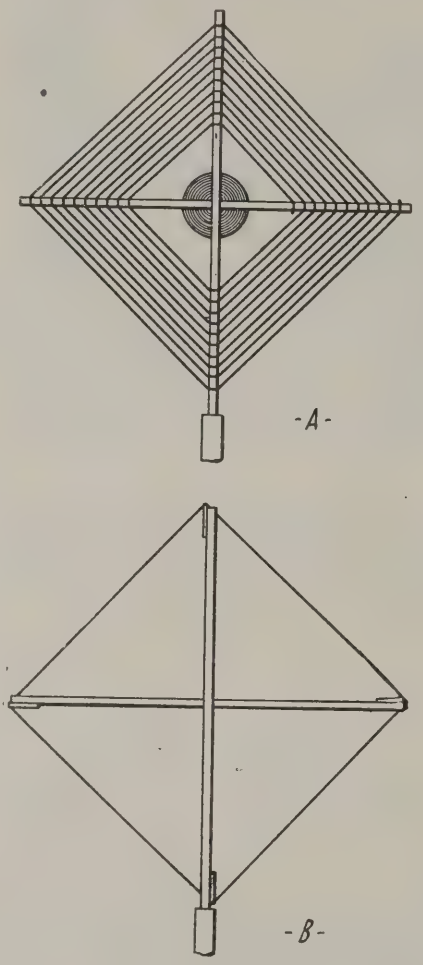


Figure 1—Square loop with oblique edges

construction. However—comparing loops with the same total inductance—in order to rotate these loops more desk or floor space is required. In the case of the types shown in figures 1b and 2b less space is required to rotate, but the constructional details are somewhat more difficult. Comparing loops of the same maximum dimensions this type will give somewhat louder signals since the mean area per turn is greater.

In constructing loops the following details must be kept in mind. The framework should be substantial, symmetrical and stiff enough not to wobble before it is wound up, so that there will be no undue strain on the wire that will cause stretching and consequently sagging. To enable easy rotation and to keep it from swinging away from any selected direction, the framework must be mounted symmetrically about the vertical axis. Some suitable scale marked in degrees or in the points of the compass will assist in determining directions.

It is found that the size of the wire does not influence results to any great degree especially when using regenerative or radio frequency amplifying receivers. If wire smaller than No. 22 is used on loops over two feet square, there is a tendency for the wires to stretch and sag after some use. No. 18 or 16 or untwisted lamp cord is recommended. The use of Litzendraht is not warranted, in my experience, after comparing results with cost.

Figures 3 and 4 give common methods for the construction of the crosspieces at the end of the arms of a "box" type loop. All other details and all dimensions will of course depend on the results of the design problems previously outlined.

There are several ways of bringing out the connection leads from a loop. For small loops constructed of light rods, the rod supporting the whole loop can be connected to an ordinary phone plug. A jack can be mounted perpendicularly in the table or cabinet from which the connections can be made. This arrangement is not very

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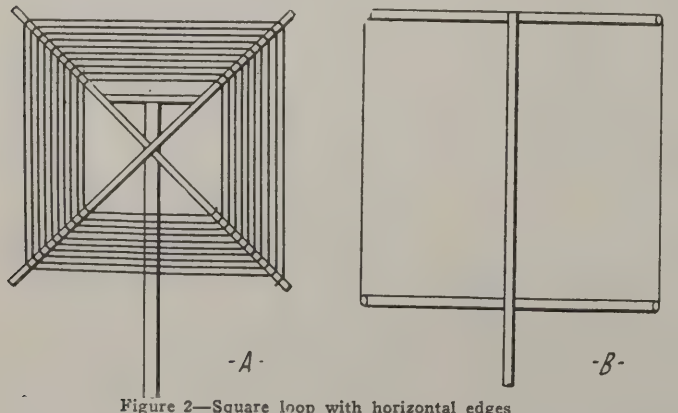
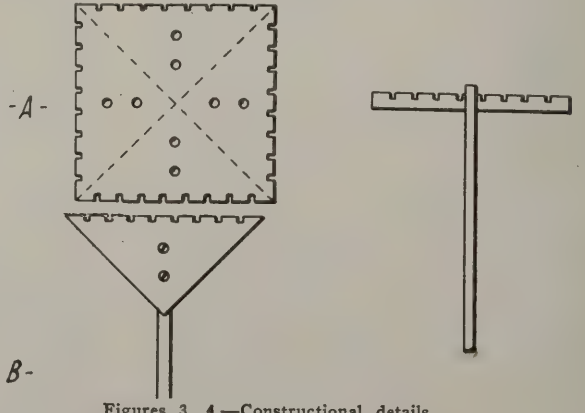


Figure 2—Square loop with horizontal edges



Figures 3, 4—Constructional details

Will Short Waves Revolutionize Broadcasting?

Frank Conrad's experiments result in sending broadcast programs to Europe

By W. W. Rodgers

BROADCAST stations will now be able to send their programs over great distances, and as well by day as by night. This is indicated by the results of short-wave broadcasting experiments which have lately reached remarkable results.

Experiments in short-wave broadcasting by means of extremely high frequencies have reached a climax in the recent repeating of American broadcasts by British stations.

The feat whereby American broadcasts are repeated on these short waves and received and rebroadcasted by English stations, thus reaching the peoples of Great Britain, France, Germany, Belgium and the Scandinavian countries, is the outcome of two years' experimenting and perfecting of high frequency apparatus by Frank Conrad, assistant chief engineer of the Westinghouse Electric & Manufacturing Company.

It was the old problem of interference that first brought the idea to Mr. Conrad and his associates that extremely high frequencies held many possibilities for the perfecting of broadcasting. He started experimenting with his own station and from a short-wave station installed on the roof of the Westinghouse plant, where the transmitting apparatus of KDKA is located.

The first experimenting with short waves under 100 meters was made between the station at KDKA and amateurs living in the Pittsburgh vicinity. Encouraged by the results of these tests, a receiving and rebroadcasting station was located in the Westinghouse building at Cleveland. The first of KDKA's broadcasts to be repeated were transmitted from the station, whose call letters are KDPM. Then tests were made between East Pittsburgh and Springfield, Mass., which also were successful, and finally, short-wave or high-frequency receivers were installed in the homes of amateurs living in some 20 cities located so that they covered the country. All holders of these sets reported that reception on short waves was very favorable and that there were none of the drawbacks to broadcast reception found on the higher wave lengths.

These experiments covered a period of two years, nearly up to the time when KFKX, the first radio repeating station in the world, was started by the Westinghouse Company at Hastings, Nebraska, last October. This repeating station made use of the high frequency broadcasting and reception for the repeating of KDKA's East Pittsburgh, Pa., concerts.

Antenna system of KDKA's 100-meter transmitter at Pittsburgh

The KFKX station operated so successfully that negotiations were started with friendly concerns located in Great Britain to test the reception of high frequency waves. It was found that the high frequency signals crossed the Atlantic with the same ease that they crossed the United States.

Europe Hears KDKA Concerts

The repeating was carried on with the British Broadcasting Co. Six or seven of this company's stations were tied together by means of telephone lines and the repeating of KDKA's concerts was started. The result of this was that the people living in Great Britain and Eastern Europe heard American concerts as plainly as they could hear their own stations and with the same receiving sets. It was the greatest triumph that radio had made in the past year and has actually changed the whole future of broadcasting.

The high frequency transmitter that does the repeating is located on top of a nine-story building in the Westinghouse plant at East Pittsburgh, Pa. Because of the fact that high frequency sets are sensitive and can be thrown off their wave easily, the whole set is mounted on springs to guard against jars. To prevent the swinging of the antenna, it is drawn taut between its uprights and the down leads consist of copper tubing. The various inductances on the set are wound on rigid forms with copper tubing forming all leads. The transmitting set consists of three panels, as follows: The rectifier panel, the modulator panel and the oscillator panel. All the equipment represents the last word in transmitting apparatus with water-cooled tubes and special condensers.

The short-wave transmitter is almost an exact duplicate of the big transmitting unit at KDKA with the changes necessary to efficiently work on the high frequencies.

Short Antennas Are Best

One of the most striking things about the short-wave transmitting set is the extremely short antenna used. The antenna at KDKA for use with the short-wave receiver is slightly in excess of 35 feet, in striking contrast with the 200-foot antenna used for regular broadcasts.

In England the law prohibits the use of large antennas, with the result that most of them are under 40 feet. The result of this is that radio frequency receivers are the common apparatus used, so that the reception of the short-wave signals is ideal on the Continent.

The great difference in frequency between the short-wave broadcasts (under 100 meters) and the common wave length band, approximately 360 meters, can be noted by comparing the kilocycle frequency of two such waves. East Pittsburgh commonly transmits to England on a wave length of 94 meters, which is a frequency of 3,200 kilocycles. At the same time KDKA is broadcasting to its regular broadcast audiences of 326 meters, which is a frequency of 960 kilocycles. This difference in frequency tells much of the story of the short-wave broadcasting.

Tests have proved that the high frequency broadcasts go farther with the same power input than the ordinary broadcast waves. It has also been proved that daylight has little effect, if any, on this carrying power. These two qualities of the short waves are what is going to affect the future of broadcasting.

Peeps into Broadcast Stations

WGY "Puts the Cat Out" on the Air

IN the selection of its announcers WGY has endeavored to get men who could do a little more than announce.

Kolin Hager, chief announcer and in charge of the studio is a tenor; during his college days he captured all kinds of medals for declamation and debate; he had an ambition for grand opera and studied Italian, Spanish, French and German. As a result when he gives the name of a foreign composer you are almost certain it's correct. Mr. Hager has also had considerable experience as an actor and for two years taught English in a High School. And it takes an actor to teach anything in a High School, nowaday.

Asa O. Coggeshall is a tenor, pianist and organist and when he isn't announcing he is directing a boy choir at St. Ann's Church, Amsterdam, N. Y.

Carl Jester is also a tenor—WGY runs to tenors. He is soloist in a Schenectady church and has mastered both French and German. He's the one who directs the numerous light operas given by WGY—the Gilbert and Sullivan group, and others.

Edward H. Smith can't sing and he admits it, but he has the voice for announcing. Mr. Smith has had several years' experience in the theatre. He knows the drama and as a director of the WGY players has had a hand in one of the most popular features of the station—the radio drama.

Mr. Smith has also planned special features such as "Farmers' Night," "Josh Quinby," "Minstrels," "A Night at the Club," and a "Cabaret Entertainment." These affairs are quite "different." The programs are continuous, the announcing being a part of the show so that the radio audience feels that it is actually present.

At the conclusion of Josh Quinby's golden wedding anniversary, after the guests had left the house Josh called for the kitty to put her out for the night. His "Here kitty, kitty" call went out over the country and within a few days WGY received six letters from listeners who reported how their own cats had acted when the "kitty, kitty" came through their loud speakers (the writers', not the cats').

Some time ago, a letter was received from Mrs. Dennis L. Wilson as an expression of gratitude for what their programs meant to the little community in the northwest corner of Orr's Island, Maine. She said that were it not for WGY, they would face a monotonous winter of bleak isolation. There are weeks at a time in which the little community is cut off from outside world or even their nearest neighbors, except through radio.

Marguerite Manierre

"Three Thousand Years Ago" Spoils Rampage Nights

WCAE has been heard regularly in Hawaii, England, Alaska, and South America.

Mr. Thomas McLean, the chief operator, has a pet theory as to the consistent long range of this station. He claims that his small vertical antenna, without series condensers, does the trick. When a certain party was informed that the studio was located on the roof of the Kaufman & Baer Co. Bldg. they had visions of being housed in a large tent!

Thomas McLean, Chief Operator, was one time a signal officer in France and was several times commended for his ingenuity in offsetting German activities in the way of electrically operated machine guns, and loaded trip-wires and remote control of high explosives. Heinie was greatly surprised when they failed to work owing to the fact that Mr. McLean had playfully inserted a high resistance in series with the lines so that they appeared to be O. K. but, nevertheless, would not work.

Radio rampage nights have proven popular to WCAE's unseen audience, but just when things are breaking fine, Johnnie Mack, the announcer with the singing voice, has to spoil proceedings by singing, "Three Thousand Years Ago." Some day, it is hoped, he'll learn a new one. On rampage nights fifty to seventy-five entertainers are invited and the microphone is opened "wide" about eight o'clock and remains open until eleven-thirty, allowing "wise cracks" and the like to go on the air.

"Many Waters" on the Air

AWAY back in 1805, Lewis and Clark found an ideal location for a trading post.

The city of Walla Walla (many waters) was established in 1859 after the Hudson Bay Company had succeeded the original traders, the Northwest Company. And since that time this city has always been one of the leading towns in the state of Washington.

Station KFCF represents the latest progress of Walla Walla.

Through the Radio Committee of the Chamber of Commerce, the surrounding towns are co-operating to provide the best of talent on the programs from KFCF which has been heard in nearly every state of the Union.

Mississippi Steamboat Whistle

RADIO fans were startled when the innovation of broadcasting the Mississippi steamboat whistle was first inaugurated by Station WMC, Memphis, Tenn. It has now become known all over the United States, in Canada, Mexico and Cuba.

WMC specializes on general orchestral music with a sprinkling of Memphis Blues from Beale Street, home of the blues, with special midnight frolics on Tuesdays and Fridays!

Among their star performers are Bob Miller's Idlewild Orchestra. They

Princess Nacoomee

also broadcast the orchestras from the Hotel Chisca and Hotel Gayoso.

A particularly delectable bit of radio glee is the negro "spirituals" which have become a regular feature of the programs at WMC. And with a miscellaneous program of lively, Memphis-ized numbers, this station has won its "Down in Dixie" laurels.

Overtones of the Voice of the Capitol

SO many interesting people are broadcasting from WRC that it is impossible to mention more than a few of them in these pages. Among them are to be found some of the most important national figures, with which Washington naturally teems, especially in these winter months. Along in the first month of the new year came Secretary of the Navy Denby, and Secretary of War Weeks a little later. Mr. Denby surprised the station personnel by strolling in quite unattended. But he had plenty of company in the studio, which was crowded to its utmost capacity with the members of the famous Marine Band, who gave a concert the same evening. Mr. Roger Bruce Lum, studio director, states that Mr. Denby found his experience somewhat trying. Visiting battleships is evidently much more in the Secretary's line than broadcasting. He fidgeted and was quite impatient while awaiting his turn to talk into the microphone. And it might be remarked that there is nothing unusual in that. Many seasoned platform speakers display similar emotions when about to address by radio an unseen audience whose magnitude can only be guessed.

Not long ago the Washington audience was treated to a song recital by Marguerite Manierre, who has an exceptionally pleasing soprano voice, and sings occasionally from the New York stations. Her group of songs included such charming numbers as the ever popular "Fiddle and I," Rimsky-Korsakoff's "Chanson Hindou," "Sweet and Low," "The Last Rose of Summer," "Comin' Through the Rye," Schubert's "Who is Sylvia" and Jessie Johnson's "Pierrot."

Mr. R. E. Edmunds, the program manager, who generally constitutes himself a reception committee in the evening to receive with proper courtesy the artists and dignitaries who perform from his station, had the opportunity of welcoming royalty recently, when Princess Nacoomee broadcast a recital from WRC. Princess Nacoomee has several charming attributes. In the first place she is American royalty and not of the hyphenated variety. Her father is Chief Tahan of the tribe of Osage Indians, a personage well known throughout the country for his lectures and work in behalf of the Indian peoples. Then the Princess is an accomplished violinist and gives a unique recital wherein she combines the relation of the meaning of music in the life of the Indians, in their ceremonies and rituals, and the account of some interesting Indian legends, with the rendition on the violin of those same legends as done into music by some of our modern composers. The princess studied at the New England Conservatory of Music, but she gets her intimate and exact knowledge of Indian music from the considerable part of her life spent among the Indians.

Miss Florence Macbeth of the Chicago Civic Opera Company

The princess has become widely known through her appearance in most of the larger cities where she has given her recital. But she had never before broadcast, whereby hangs a bit of a tale. She customarily gives her recitals in costume, but she did not consider it necessary to don her Indian garb upon the occasion of her visit to

WGY FAMILY
Left to right: Carl Jester, Mrs. Wm. J. Cramb, Kolin Hager, Robert Weidow, Asa O. Coggeshall and Edward H. Smith

BROADCASTING SERVICES IN ZION TABERNACLE

Visitors are always welcomed at both station WCBD and Shiloh Tabernacle; it is a fallacy to think that Zion is a kind of Forbidden City, the portals of which are opened to only those who are adherents to the religious tenets observed by the citizens. Programs are made up of numbers by the Zion Junior Choir of 150 children, Zion Male Choir of 40 voices, Zion Women's Choir of 20 voices, Zion Band of 50 pieces and the Zion White-robed Choir of 500 voices

WRC, where she was to play Cecil Burleigh's "Snake Dance," Cadman's popular "From the Land of the Sky Blue Water," and "The Spirit of Wanna" by Lieurance.

A BEAUTIFUL INDIAN LEGEND

Prior to playing "The Spirit of Wanna" Princess Nacoomee tells the beautiful legend which is based upon a fine Indian love story. Wanna was a Kiowa (plains Indian) girl, and Wanna married a Pueblo man who forthwith took her to his home, built among the mesas and cliffs. There she became very homesick for her own people and longed with a great longing to visit again the familar scenes of her girlhood. With her husband she started upon the long journey to her former home, but she became ill on the way. With her strength exhausted she lay for days under a mesquite bush, hoping to regain sufficient strength to continue her journey. But one evening, as the sun "was slipping over the edge of the world" as the figurative Indian expresses it, she died. Her husband buried her under the mesquite bush, but not knowing the custom of her people of burying their dead with their ornaments, through which potency they were enabled to pass through the vale of darkness to the happy hunting ground, he buried Wanna without her ornaments. So Wanna still grieves where she lies under the mesquite bush and people who pass can still hear faintly the lament of her tortured spirit.

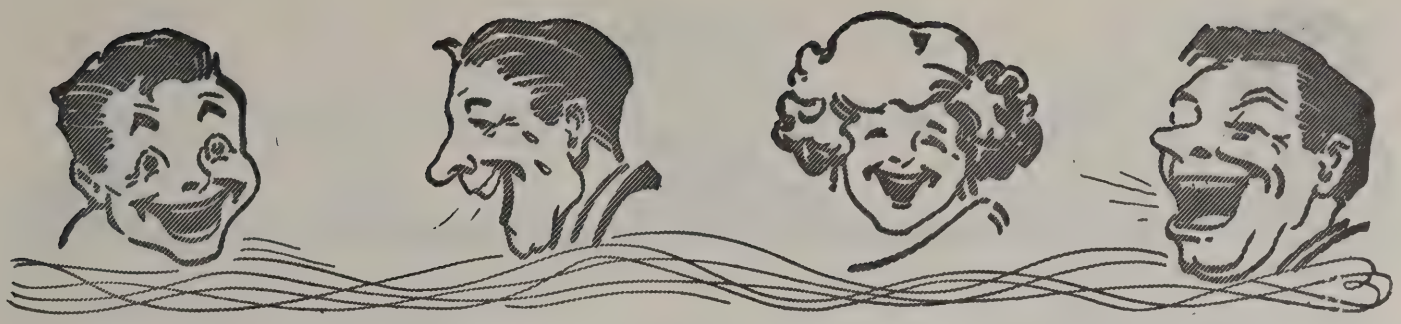
So much for the unfortunate Wanna. Now to return to the Princess Nacoomee who is telling this tale for the first time in a broadcast studio. Palpably nervous over the novel experience of talking to an unseen audience, she reached the point where she was to explain about the ornament business. At this point in the story it has been her habit to fumble at her throat and draw through her fingers a real Indian necklace which she thus displays by way of illustration to her audience. On this occasion too, she reached mechanically for her Indian beads. Her fingers found nothing to seize upon. Her mind, puzzled in subconscious fashion, failed somewhat in its certain control of things, and the voice in the microphone faltered. It is little things like this that throw an artist easily out of poise. Probably when the Princess broadcasts again she will find it advisable to wear her Indian garb.

Scholarship winners who recently entertained President Coolidge broadcast from WOR. Left to right: Angela Frances McCosker, Lillian Kay, Marion Stickel, Florence Hynes, Harold Polk, Buddy Egner, Elaine Egner and Elizabeth Mazalkovics

Musical Culture of Zion

ON the shores of Lake Michigan, midway between Chicago and Milwaukee, two graceful sturdy antenna masts tower 150 feet above Zion, the unique city founded by the late Dr. John Alexander Dowie. They mark the site of Station WCBD the radio telephone broadcasting station owned and operated by Wilbur Glenn Voliva, General Overseer of the Christian Catholic Apostolic Church.

Station WCBD is strategically located for perfect transmission. It is situated on a level plain a few miles south of the Wisconsin boundary line.



Laughter on the Radio Wave

METROPOLITAN MOVIES

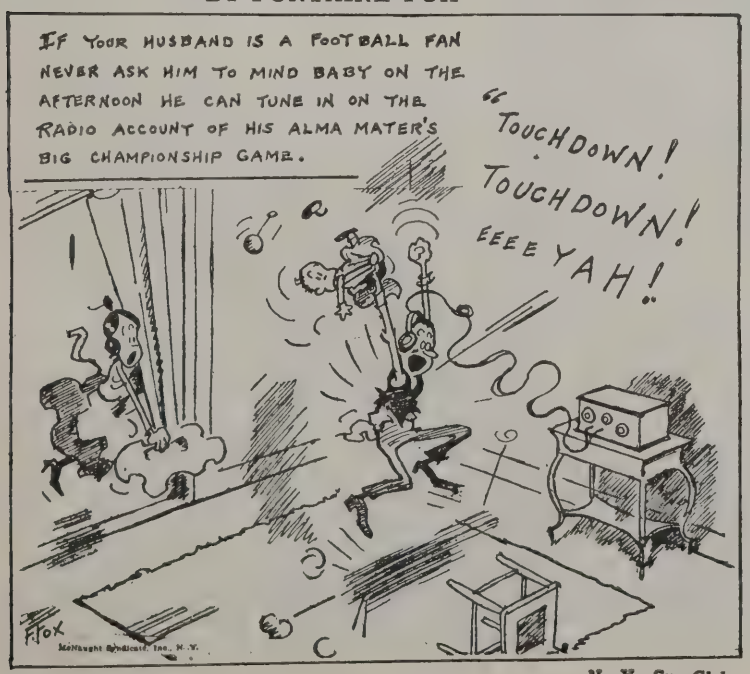
N. Y. World.

WHEN A FELLER NEEDS A FRIEND—BY BRIGGS

ITH THITH YOU THAMMY? WELL, THITH ITH THUSIE BROWN AND MY MAMA THAID I COULD COME OVER TO YOUR HOUTH AND PLAY-
ALL-RIGHT
JUST WHEN HE GOT ALL TUNED IN PERFECTLY ON HIS RADIO SUSIE BROWN ANNOUNCES SHE IS COMING OVER — BLAH!
BRIGGS '23.

N. Y. Tribune

"ADVICE TO MOTHERS—BE RADIANTLY CAREFUL" BY FONTAINE FOX


IF YOUR HUSBAND IS A FOOTBALL FAN NEVER ASK HIM TO MIND BABY ON THE AFTERNOON HE CAN TUNE IN ON THE RADIO ACCOUNT OF HIS ALMA MATER'S BIG CHAMPIONSHIP GAME.
"TOUCHDOWN! TOUCHDOWN! EEEE YAH!
FOX

N. Y. Sun-Globe

"WHY DO THEY CALL IT WIRELESS?"

COME ALONG, UNCLE YOU MUST SEE THE NEW WIRELESS IVE MADE
CAREFUL!
STEADY!
ETHEL HERE'S UNCLE
HE'S COME TO SEE OUR WIRELESS
BUT WHY CALL IT WIRELESS?
TIDGEWELL

From Tit-Bits

RADIO NEWS FROM ALL OVER THE WORLD

White's Radio Bill Practically Ready

THE revised White Radio Bill is now understood to have been generally approved by the Department of Commerce. The bill will be introduced in the House and referred to the Merchant Marine and Fisheries Committee. Public hearings will then be held, for suggestions and complaints from the interests affected. It is also believed a similar bill will be presented in the Senate.

In general, the bill will provide for the continued inspection and licensing of all American ship and shore transmitting stations, including commercial, private, broadcasting and amateur stations, as well as the examination and licensing of all operators by the Department of Commerce. General regulations of all sending stations and operators, together with license fees, location of stations, the assignment of wave lengths, power and hours, will be placed in the hands of the Secretary of Commerce. Existing licenses, however, will be permitted to run until they expire. An advisory committee of 15 experts, commercial and governmental officials will also be authorized to aid the Commerce Secretary. Assurance is given that receiving stations will not be required to secure licenses nor pay fees.

New Zealand Hears Massachusetts

ALL records were broken for commercial 600-meter continuous wave transmission when Operator M. A. Obradovic, of the *West Nilus*, while 95 miles north of Wellington, New Zealand, copied a number of messages direct from WIM, the Radio Corporation of America station at Chatham on the Massachusetts Coast. The distance is 9,300 miles and perfect reception was obtained in broad daylight.

Operator M. A. Obradovic, whose reception has been checked and confirmed, sent a letter to Chatham on December 23rd, in which he reported the history making achievement. The letter which reads in part as follows, reached the United States more than fifty days after it was mailed in New Zealand:—

"Enclosed is one of a number of a number of messages I have been copying from WIM on 600-meter C.W. The enclosed was copied in broad daylight at 7.10 P. M., New Zealand time, on December 16th (2.40 A. M. your local time), while 95 miles north of Wellington, N. Z., en route from Auckland."

Marshall Nielan directing a movie scene by radio

The Austro-Marconi Radio Co.

THE Austro-Marconi Radio Company inaugurated a regular Austrian wireless service. The opening was attended by the chiefs of the Government and representatives of the business world in Vienna.

The first messages sent out were addressed from Chancellor Seipel to the League of Nations at Geneva; from Burgomaster Sietz to Mayor Hylan of New York; and from the Chamber of Commerce of New York and London.

R C A in Public Interest

IN reply to the complaint of the Federal Trade Commission that great electrical companies have conspired to create a monopoly in radio apparatus officials of the three companies most concerned have issued statements to the effect that their methods have resulted in expansion rather than restraint of trade and have been in the best interests of the public.

The Radio Corporation of America was formed at the request of the Navy Department officials and for some time a representative of the Government served on the Board of Directors. It is also pointed out that the rapid development of the industry has been the result of the joint use of all the companies' patents.

Mr. Gerard Swope, President of the General Electric Co., said in part:

"The General Electric Company had developed a high frequency generator. The thought of the company at first was to sell this apparatus to any company that desired to have it, but at the request of one of the departments of the United States Government the General Electric Company was induced to take the lead in the reorganization of the American Marconi Company, which eventuated in the formation of the Radio Corporation of America, with the entire elimination of foreign interest.

"To make the Radio Corporation the most efficient instrument for transoceanic communication, the General Electric Company made a contract with the Radio Corporation giving to the latter the benefit and the advantage of all its inventions. Further to strengthen the position of the Radio Corporation in this art, similar contracts were made with other companies.

"This was all known to the Government, and a representative designated by the Government sat on the Board of Directors of the Radio Corporation for some time after its organization."

Major General James G. Harbord, President of the Radio Corporation of America said:

"The Radio Corporation has already opened all its records, correspondence, files, minutes of the meetings of its Board of Directors, together with all

its contracts and agreements, to the representatives of the Federal Trade Commission. The commission itself has fully reported the result of its survey to Congress.

"The Radio Corporation of America was organized as the outgrowth of a request of responsible officers of the Navy Department in Washington that there be established a strong, purely American company to carry the banner of the United States in this field of international communications and to effectively compete with foreign-owned or controlled systems of international communications."

President H. B. Thayer of the American Telephone & Telegraph Company, of which the Western Electric Company, is a subsidiary, said:

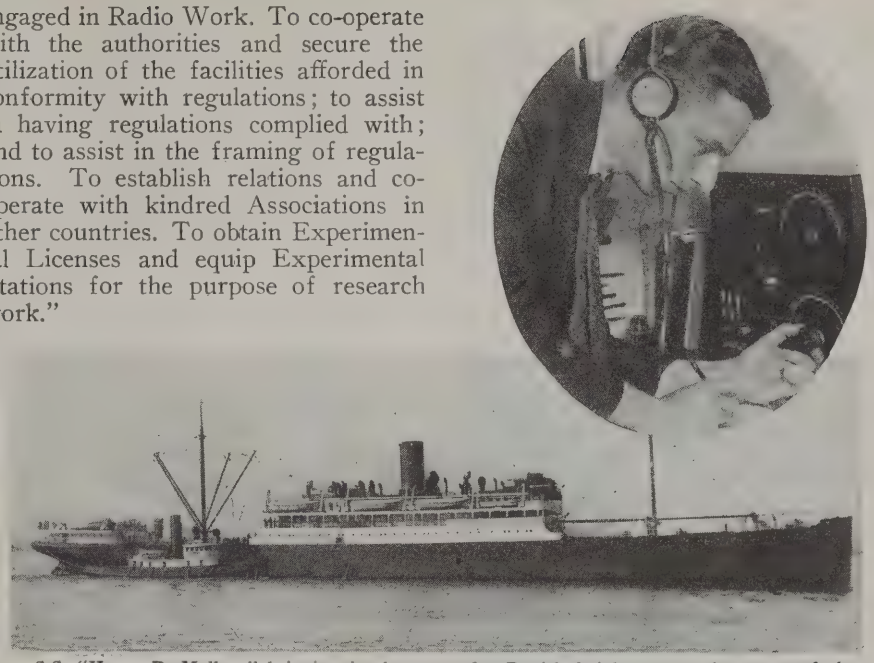
"We presume that so far as we are concerned the complaint rests on a contract made by us with General Electric and dated July 1, 1920. In our first annual report after that contract was made we stated its purpose and scope which from our point of view was to clear up the patent situation which might hamper our development. The effect has not been to restrain trade, but to expand it. We believe the contract is in the public interest and have been advised that it stands on a sound legal basis."

Ireland Now Has Radio Association

THE awakening interest in radio development in the Irish Free State has prompted a group of professors, electrical engineers, and other prominent persons interested in radio work to organize a society which is to be called "The Radio Association of Ireland." This Association is to have its head office in Dublin, and according to its constitution its objects are:

"To foster the interests of members engaged in Radio Work. To co-operate with the authorities and secure the utilization of the facilities afforded in conformity with regulations; to assist in having regulations complied with; and to assist in the framing of regulations. To establish relations and co-operate with kindred Associations in other countries. To obtain Experimental Licenses and equip Experimental Stations for the purpose of research work."

All radio license holders and others interested in the development of radio science and radio communication are eligible for membership. The membership fee is to be ten shillings per annum—equivalent to $2.20 at current rate of exchange—and the funds so collected are to be used in carrying out the various programs of the Association and in equipping experimental stations. The Association is also planning to publish a periodical devoted to radio work when its membership is large enough to finance such an undertaking. Already several hundred applications for membership have been received, and it is expected that the number of applicants will swell considerably when the contemplated Broadcasting Station has been established at Dublin, and the present restrictions upon private ownership of wireless sets have been removed.



S.S. "Henry R. Mallory" bringing in the crew of a Danish freighter rescued at sea and the radio operator who heard the SOS

American Radio Exports Grow

RADIO exports for the year 1923, totaled $3,448,112, compared with $2,897,799 last year, according to Department of Commerce statistics. While the shipments of radio apparatus form only about 5 per cent. of the total value of all electrical exports, which in 1923 passed the $72,000,000 mark, radio exports increased about 7 per cent. out of a total gain of $9,000,000. December radio exports totaled $335,308, compared with $381,827 for November and $270,061 in October. In November, the bulk of American radio apparatus sent out of the country went to Argentina, Quebec, Ontario, Australia, Panama, Mexico and England. Twenty-four countries purchased apparatus valued at over $1000 from American exporters.

Listening to KDKA, Pittsburgh, in the Hudson Vehicle Tunnel, New York

Radio Broadcasts Wilson Services

THE funeral services of President Wilson in Washington were broadcast Feb. 6, to probably 5,000,000 persons east of the Mississippi River by the American Telephone and Telegraph Company through three high-power stations, while the memorial exercises held in Madison Square Garden, N. Y., were broadcast by the Radio Corporation station WJZ.

The three large radio stations which were linked to broadcast the funeral services in Washington were the same that recently broadcast Mr. Wilson's address from his home in S Street, the same that broadcast President Coolidge's message to Congress, and the services of the Unknown Soldier in the National Cemetery at Arlington.

Chief Harry T. Baxter broadcasting the history of the "Liberty Bell" at Philadelphia

No Broadcasting Stations in Spain

ALTHOUGH no broadcasting stations have as yet been established in Spain, there is considerable interest in radio receiving sets of sufficient range to receive broadcasts from Paris, The Hague, Berlin and London. The principal drawback to a more extended use of radio receiving apparatus is the apparent lack of technical knowledge on the part of those who have undertaken the sale of radio apparatus. An investigation has disclosed that out of five dealers who carry radio receiving sets in stock, mainly of British and French manufacture, only one seemed to have much knowledge of the subject.

New Wireless Station Opened in Argentina

THE new wireless station which has been built at Monte Grande for the Transradio Internacional Compania Radiotelegrafica Argentina for the purpose of placing the Argentine in direct wireless communication with North America, Europe, and the Far East, was opened January 25 when an inaugural message was sent from the President of the Argentine to King George V. Direct services will be carried out between Monte Grande, New York, Paris and Berlin. It is intended to extend this direct service to England as soon as possible, but as Great Britain does not possess a wireless station sufficiently powerful to communicate with South America this service canot be brought into operation until a suitable station is available in that country.

The transmitting station at Monte Grande, 20 kilometers from Buenos Aires, covers an area of 1200 acres. There are ten steel towers 500 meters apart, each tower being 690 feet high. The power of the station is 800 kw. .

The receiving center is at Villa Eliza, 39 kilometers from Buenos Aires and the same distance from the transmitting station.

The telegraph office, from which the transmitting station is automatically controlled and to which the receiving station is connected with telegraph lines and an automatic linking device is situated in the center of the commercial quarter of Buenos Aires.

British Restrict Radio on Foreign Ships

THE British Admiralty has issued an order restricting the use of radio telegraph or telephone apparatus by foreign warships when in or near British harbors.

If the harbor is a naval one, such ships must obtain permission from the naval port commander before employing any of these services; they must furthermore state the system, wave length and time of transmission proposed.

In other harbors, transmission on 600 meters is forbidden, except for distress signals. Interference with naval and military signaling must be avoided, and transmission must be discontinued on request of the authorities.

B C L's Relieved of Interference

SPARK interference from ships operating on 450 meters, which has been giving broadcast listeners along the coast considerable trouble since the broadcasting wave band was increased last May, became a thing of the past on Jan. 11, when the meeting presided over by Arthur Batchelder, Chief Radio Supervisor of the 2d District, came to the conclusion that the interference must go and raised the wave band of all ships using spark transmitters to between 600 and 800 meters.

The meeting took on an international aspect inasmuch as the Canadian Government sent C. P. Edwards, Director General of Canadian wireless and radio activities to advise and co-operate with the American authorities and interests in cleaning up an ugly situation. The commercial companies were all represented and were all unanimous in their approval of the change.

Wall Street Resorts to Radio

WIRE service with the West was so badly crippled by the recent sleet storm that Wall Street turned to radio for relief. The Radio Corporation showed its ability to handle business from New York to San Francisco and covered points in the southern section of the country as well. The American Telephone and Telegraph Company reported but one of its fourteen circuits to Chicago in working order, and it accepted only emergency messages over its single circuit. Wires of the Western Union and the Postal Telegraph around Chicago were reported in bad shape.

Japan Improves Stations

JAPAN is doing much to improve her short wave wireless communication, but thus far nothing has been done to make communication with the outside world quicker.

The Funabashi naval station just outside Tokio is being modernized and new short wave stations are being erected in Chiba and Niigata, but these are largely for communicating with ships and between different parts of Japan.

The syndicate headed by Viscount Shibusawa, which proposed erection of a trans-Pacific station, was somewhat embarrassed by the disaster, but is understood to be inclined to go on with its project if suitable arrangements can be made with the government for a subsidy.

Radio Traffic Grows

THE transatlantic traffic of the Radio Corporation of America is now at the rate of 90,000 paid words a day and is steadily increasing, because of the large number of new customers using radio letters as well as messages.

John W. Swanson, of the Dr. Alexander Rice expedition, operating a set in a South American jungle

BROADCASTING STATION DIRECTORY

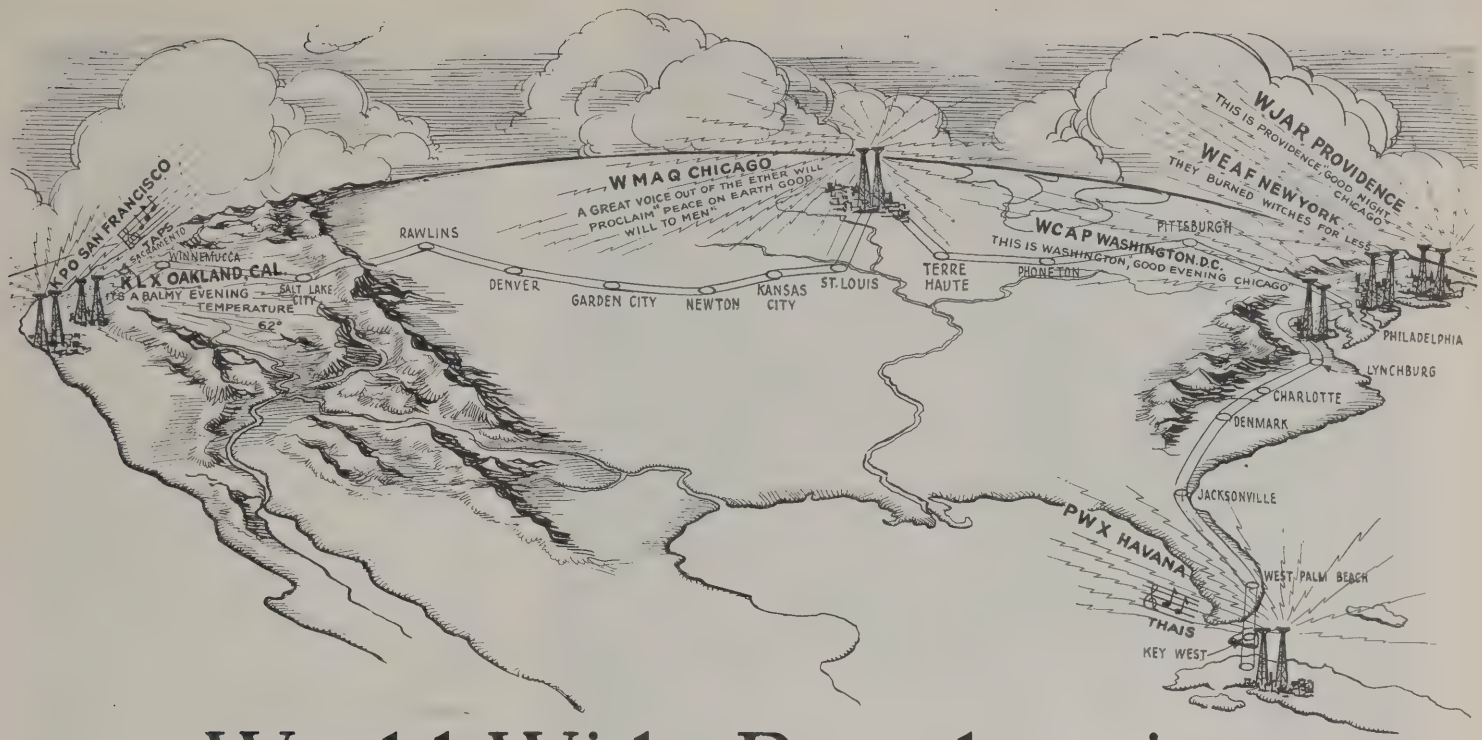
(Revised to February 15th, 1924)

KAO	Young Men's Christian Association, Denver, Colo.	360
KFI	E. C. Anthony.....Los Angeles, Calif.	469
KFZ	Doerr Mitchell Electric Co.....Spokane, Wash.	283
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGU	M. A. Mulrony.....Honolulu, Hawaii	360
KGW	Oregonian Pub. Co.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould .....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	270
KJS	Bible Institute of Los Angeles, Inc., Los Angeles, Calif.	360
KLS	Warner Brothers .....Oakland, Calif.	360
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMC	Lindsay-Weatherill & Co.....Readley, Calif.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.	360
KOP	Detroit Police Dept.....Detroit, Mich.	286
KOQ	Modesto Evening News.....Modesto, Calif.	360
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herreld.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	278
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Rsch. Lab., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	The Examiner Printing Co., San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KWY	Westinghouse Elec. & Mfg. Co.....Chicago, Ill.	536
KXD	Herald Publishing Co.....Modesto, Calif.	252
KYQ	Electric Shop .....Honolulu, T. H.	360
KZM	Preston, D. Alien.....Oakland, Calif.	360
KZN	The Desert News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
KDKA	Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDLY	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre .....San Diego, Calif.	252
KDYQ	Oregon Institute of Technology...Portland, Ore.	360
KDYW	Smith, Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin Publishing Co...Honolulu, T. H.	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Company .....Seattle, Wash.	455
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Pyle & Nichols.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KDZU	Western Radio Corporation.....Denver, Colo.	360
KDZV	Cope & Cornwell Co.....Salt Lake City, Utah	360
KFAD	McArthur Brothers Mercantile Co., Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corporation.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder Colo.	360
KFAN	Electric Shop .....Moscow, Idaho	360
KFAR	Studio Lighting Service Co.....Hollywood, Calif.	280
KFAT	Dr. J. T. Donohue.....Eugene, Ore.	275
KFAU	Independent School District of Boise City, Boise, Idaho	270
KFAV	Abbot Kinney Company.....Venice, Calif.	258
KFAY	W. J. Virgin.....Medford, Ore.	283
KFAW	The Radio Den, Ashford & White, Santa Anna, Calif.	280
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill.....San Diego, Calif.	360
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Chronicle News and Gas & Elec. Supply Co., Trinidad, Colo.	360
KFBU	Bishop N. S. Thomas.....Laramie, Wyo.	283
KFCD	Salem Elec. Co.....Salem, Ore.	360
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station.....Billings, Mont.	360
KFCK	Colorado Springs Radio Co., Colorado Springs, Colo.	242
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCQ	Motor Service Station.....Casper, Wyo.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....LeMars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michaels Cathedral.....Boise, Idaho	360
KFDF	Wyoming Radio Corp.....Casper, Wyo.	360
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agri. College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. E. Cutting.....Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods, York, Nebr.	360
KFDU	Nebraska Radio and Electric Co., Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College of Agri. & Mech. Arts, Brooklings, S. D.	360
KFDZ	Harry O. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Ft. Dodge, Iowa	231
KFEV	Radio Electric Shop.....Douglas, Wyo.	263
KFEX	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Const. Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engrs., St. Louis, Mo.	360
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFJ	Jenkins Furniture Co.....Boise, Idaho	360
KFFO	Dr. E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Markschoffel Motor Co....Colorado Springs, Colo.	360
KFFR	Jim Kirk .....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy, Inc.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGF	Buchanan Stevens & Co.....Mt. Vernon, Wash.	360
KFGH	Leland Stanford, Jr., Univ..Stanford Univ., Colo.	360
KFGJ	National Guards Co., 138th Inf., St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Co., Berrien Spgs., Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	The Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	283
KFHJ	Fallon Co. .....Santa Barbara, Clif.	360
KFHR	Star Elec. and Radio Co.....Seattle, Wash.	270
KFHS	Robert Washington Nelson....Hutchinson, Kans.	229
KFIB	Franklin W. Jenkens.....St. Louis, Mo.	244
KFIC	Philip Laskowitz .....Denver, Colo.	224
KFID	Ross Arbuckles Garage.....Iola, Kans.	246
KFIF	Benson Tech. Student Body.....Portland, Ore.	360
KFIK	Gladbrook Electric Co.....Gladbrook, Iowa	234
KFIL	Windisch Elec. Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	224
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ, Latter Day Saints, Independence, Kans.	240
KFIY	Brott Laboratories .....Seattle, Wash.	236
KFIZ	Daily Commonwealth .....Fond du Lac, Wisc.	273
KFJB	Marshall Electric Co., Inc....Marshalltown, Iowa	248
KFJC	Post Intelligences .....Seattle, Wash.	233
KFJD	Weld County Printing & Pub. Co., Greeley, Colo.	236
KFJF	National Radio Mfg. Co...Oklahoma City, Okla.	252
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJM	University of North Dakota, Grand Forks, N. D.	229
KFJR	Ashley C. Dixon & Co.....Stevensville, Mont.	258
KFJV	T. H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College...Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, 112th Cav., Fort Worth, Texas	254
KFKA	Colorado State Teachers College...Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKH	Denver Park Amusement Co.....Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray .....Butte, Mont.	283
KFKX	Westinghouse Electric Co.....Hastings, Nebr.	286
KFKZ	Nasour Bros. Radio Co...Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Educational Service.....Denver, Colo.	268
KFLH	Erickson Radio Co., Inc....Salt Lake City, Utah	261
KFLP	Everett M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. M.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	Rev. A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co....Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Texas	240
KFLY	Fargo Radio Supply Co.....Fargo, N. D.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College.....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KFMT	Dr. George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Brothers .....San Marcos, Texas	240
KFMW	M. G. Sateren.....Houghton, Mich.	266
KFMX	Carleton College .....Northfield, Minn.	283
KFMY	Boy Scouts of America, Long Beach District Council, Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club.....Roswell, N. M.	250
KFNC	Echo Park Evangelistic Association, Los Angeles, Calif.	278
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop...Warrensburg, Mo.	234
KGO	General Electric Co.....Oakland, Calif.	312
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KWG	T. & H. Radio Co.....Anthony, Kans.	261
WSB	May & Co. .....Newark, N. J.	360
WBR	Pennsylvania State Police.....Butler, Pa.	286
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co..Springfield, Mass.	337
WCK	Stix-Baer-Fuller .....St. Louis, Mo.	360
WCM	University of Texas.....Austin, Texas	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDM	Church of the Covenant.....Washington, D. C.	234
WDZ	James L. Bush.....Tuscola, Ill.	278
WEB	Benwood Co. .....St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WFY	Cosradio Co. .....Wichita, Kans.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	242
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wisc.	360
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHK	The Radiovox Company.....Cleveland, Ohio	360
WHN	Loew's State Theatre....New York City, N. Y.	360
WHX	Iowa Radio Corporation.....Des Moines, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Electric Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WIZ	Cinco Radio Mfg. Co.....Cincinnati, Ohio	360
WJD	Richard Harris Howe.....Granville, Ohio	229
WJH	White & Boyer Co.....Washington, D. C.	273
WJK	Service Radio Equipment Co.....Toledo, Ohio	360
WJX	DeForest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corp of America—Aeolian Hall, N. Y. C.	405
WJZ	Radio Corp. of America—Aeolian Hall, N. Y. C.	455
WKA	Landaus Music & Jewelry Co., Wilkes-Barre, Pa.	360
WKY	Oklahoma Radio Shop....Oklahoma City, Okla.	360
WLB	University of Minnesota.....Minneapolis, Minn.	360
WLH	Hamilton Mfg. Co.....Indianapolis, Ind.	360
WLW	Crosley Manufacturing Co.....Cincinnati, Ohio	309
WMA	Arrow Radio Laboratories.....Anderson, Ind.	360
WMC	Commercial .....Memphis, Tenn.	500
WMU	Doubleday-Hill Elec. Co.....Pittsburgh, Pa.	261
WNJ	Shotten Radio Mfg. Co.....Albany, N. Y.	400
WNO	Wireless Telephone Co. of Hudson County, Jersey City, N. J.	360
WOC	Palmer School of Chiropractic..Davenport, Iowa	484
WOI	Iowa State College.....Ames, Iowa	360
WOK	Arkansas Light & Power Co...Pine Bluff, Iowa	360
WOO	John Wanamaker .....Philadelphia, Pa.	509
WOQ	Western Radio Co.....Kansas City Mo.	360
WOR	L. Bamberger Co.....Newark, N. J.	405
WOS	Missouri State Marketing Bureau, Jefferson City, Mo.	441
WPA	Fort Worth Record.....Fort Worth, Tex.	360
WPG	Nushawg Poultry Farm.....New Lebanon, Ohio	234
WPI	Electric Supply Co.....Clearfield, Pa.	360
WQX	Walter A. Kushl.....Chicago, Ill.	360
WRC	Radio Corporation of America..Washington, D. C.	469
WRK	Doron Brothers Electric Co.....Hamilton, Ohio	360
WRL	Union College .....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas (Police and Fire Signal Department), Dallas, Tex.	360
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273
WSB	Atlanta Journal .....Atlanta, Ga.	429
WSL	J. & M. Electric Co.....Utica, N. Y.	273
WSY	Alabama Power Co.....Birmingham, Ala.	360
WSZ	Marshall-Gerken Co. .....Toledo, Ohio	360
WTG	Kansas State Agri. College....Manhattan, Kans.	360
WTP	George M. McBride.....Bay City, Mich.	360
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	The Detroit News.....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	L. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	264
WAAQ	New England Motor Sales Co., Greenwich, Conn.	360
WAAS	Georgia Radio Co.....Decatur, Ga.	360
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.....Emporia, Kans.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence.....Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.....Anderson, Ind.	229
WABD	Parker High School.....Dayton, Ohio	286
WABE	Y. M. C. A. .....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway and Electric Co...Bangor, Me.	240
WABJ	Radio Laboratories .....South Bend, Ind.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agri. College.....Storrs, Conn.	283
WABM	F. E. Doherty.....Saginaw, Mich.	254
WABN	Waldo C. Grover.....La Crosse, Wisc.	234
WABO	Lake Avenue Baptist Church....Rochester, N. Y.	252
WABP	Robert F. Weinhig .....Dover, Ohio	266
WABQ	Haverford College Radio Club...Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt, Jr.....Nashville Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church..New Orleans, La.	263
WAJV	Indian Pipe Line Corp.....Princeton Ind.	360
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co., The Star Telegram, Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAW	Marietta College .....Marietta, Ohio	246
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratory.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	224
WBBE	Alfred R. Marcy .....Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya .....Mettapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBI	Indianapolis Radio Club.....Indianapolis, Ind.	234
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufman & Baer Co.....Pittsburgh, Pa.	462
WCAF	Michigan Limestone & Chemical Co., Rodgers, Mich.	360
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Pl., Nebr.	360
WCAK	Alfred P. Daniel..... .....Houston, Texas	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Alamo Radio Electric Co.....San Antonio, Tex.	360
WCAS	Dunworthy Industrial Institute, Minneapolis, Minn.	246
WCAT	South Dakota School of Mines..Rapid City, S. D.	240
WCAU	Durham & Co.....Philadelphia, Pa.	286

WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont.....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Music House, Milwaukee Wisc.	261
WCAZ	Carthage College.....Carthage, Ill.	246
WCBA	Charles W. Haimbach.....Allentown, Pa.	280
WCBC	University of Michigan.....Ann Arbor, Mich.	280
WCBD	Zion Radio Broadcasting Station.....Zion, Ill.	345
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star.....Kansas City, Mo.	411
WDAG	Martin J. Laurence.....Amarillo, Tex.	263
WDAH	Trinity Methodist Church.....El Paso, Texas	268
WDAK	Hartford Courant.....Hartford, Conn.	261
WDAM	Weston Electric Co.....New York, N. Y.	360
WDAO	Automotive Electric Co.....Dallas, Tex.	360
WDAP	The Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers.....Philadelphia, Pa.	395
WDAS	Samuel W. Watte.....Worcester, Mass.	360
WDAU	Slocum & Kilburn.....New Bedford, Mass.	360
WDAX	First National Bank.....Centerville, Iowa	268
WDAY	Fargo Radio Service Co.....Fargo, N. D.	244
WDBC	Kirk Johnson & Co., Inc.....Lancaster, Pa.	258
WEAA	Fallain & Lathrop.....Flint, Mich.	280
WEAE	Virginia Polytechnic Institute...Blacksburg, Va.	360
WEAF	American Tel. & Tel.....New York, N. Y.	492
WEAH	Wichita Board of Trade.....Wichita, Kans.	244
WEAI	Cornell University.....Ithaca, N. Y.	286
WEAJ	University of South Dakota....Vermillion, S. D.	283
WEAM	North Plainfield, Borough of Plainfield, North Palinfield, N. J.	252
WEAN	Shepard Co.....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co., Inc.....Mobile, Ala.	360
WEAR	Baltimore Am. & News Pub. Co., Baltimore, Md.	360
WEAS	Hecht Company.....Washington, D. C.	360
WEAU	Davidson Brothers Co.....Sioux City, Iowa	360
WEAY	Will Horwitz, Jr.....Houston, Tex.	360
WEAZ	Donald Redmond.....Waterloo, Iowa	360
WFAA	A. H. Belo & Co.....Dallas, Tex.	476
WFAB	Carl C. Woese.....Syracuse, N. Y.	234
WFAF	Henry C. Spratley.....Poughkeepsie, N. Y.	273
WFAG	Radio Engineering Laboratory, Waterford, N. Y.	360
WFAH	Electric Supply Co.....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAM	Times Publishing Co.....St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co..Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College & Cameron Radio Co., Cameron, Mo.	360
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WGAC	Orpheum Radio Stores Co.....Brooklyn, N. Y.	360
WGAD	Spanish Am. Sch. of Telegraphy, Enconada, P. R.	360
WGAJ	W. H. Glass.....Shenandoah, Iowa	360
WGAL	Lancaster Elec. Supply & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd.....Pensacola, Fla.	360
WGAQ	W. G. Patterson.....Shreport, La.	360
WGAW	Ernest C. Albright.....Altoona, Pa.	261
WGAX	Radio Electric Co., Washington Courthouse, Ohio	360
WGAY	North Western Radio Co.....Madison, Wisc.	360
WGAZ	South Bend Tribune.....South Bend, Ind.	360
WHAA	State University of Iowa.....Iowa City, Iowa	283
WHAB	Clark W. Thompson.....Galveston, Tex.	360
WHAD	Marquette University.....Milwaukee, Wisc.	360
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	Hafner Supply Co.....Joplin, Mo.	283
WHAK	Roberts Hardware Co.....Clarksburg, West Va.	258
WHAM	Eastman School of Music of Univ. of Rochester, Rochester, N. Y.	283
WHAP	Dewey L. Otta.....Decatur, Ill.	360
WHAR	Paramount Radio and Elec. Co., Atlantic City, N. J.	231
WHAS	Courier Journal & Times.....Louisville, Ky.	400
WHAV	Wilmington Elec. & Supply Co., Wilmington, Del.	360
WHAX	Huntington Press.....Huntington, Ind.	360
WHAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WIAB	Joslyn Automobile Co.....Rochford, Ill.	360
WIAD	Howard R. Miller.....Philadelphia, Pa.	254
WIAF	Gustav A. De Cortin.....New Orleans, La.	234
WIAI	Heers Stores Co.....Springfield, Mo.	252
WIAK	Journal Stockman Co.....Omaha, Nebr.	278
WIAP	J. R. Rudy & Sons.....Paducah, Ky.	360
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Burlington Hawkeye-Home Elec. Co., Burlington, Iowa	360
WIAU	American Sec. & Sav. Bank.....Le Mars, Iowa	360
WIAV	New York Radio Laboratories, Binghamton, N. Y.	360
WIAW	Saginaw Radio & Elec. Co.....Saginaw, Mich.	360
WJAD	Jackson's Radio Eng. Lab.....Waco, Tex.	360
WJAF	Press Pub. Co.....Muncie, Ind.	360
WJAG	Norfolk Daily News.....Norfolk, Nebr.	283
WJAJ	Y. M. C. A.....Dayton, Ohio	360
WJAK	Rev. C. L. White.....Greentown, Ind.	254
WJAM	D. C. Perham.....Cedar Rapids, Iowa	268
WJAN	Peoria Star Co.....Peoria, Ill.	280
WJAR	The Outlet Co.....Providence, R. I.	360
WJAS	Capper Publications.....Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co.....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory.....Chicago, Ill.	448
WKAA	H. F. Paar.....Cedar Rapids, Iowa	268
WKAD	Charles Looff.....East Providence, R. I.	240
WKAF	W. S. Radio Supply Co. and Wm. Schack, Wichita Falls, Tex.	360
WKAN	Alabama Radio Mfg. Co.....Montgomery, Ala.	360
WKAP	Dutee Wilcox Flint.....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College....East Lansing, Mich.	280
WKAV	Laconia Radio Club.....Laconia, N. H.	254
WKAW	United Battery Service Co. Montgomery, Ala.	226
WKAY	Brenau College.....Gainesville, Ga.	280
WLAG	Cutting & Washington Radio Corp., Minneapolis, Minn.	417
WLAH	Samuel Woodworth.....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Mach. Co.....Bellows Falls, Vt.	360
WLAL	Tulsa Radio Co.....Tulsa, Okla.	360
WLAN	Putnam Hardware Co.....Houlton, Me.	283
WLAP	W. V. Jordon.....Louisville, Ky.	360
WLAQ	Arthur S. Schilling.....Kalamazoo, Mich.	283
WOAR	Henry P. Lundskow.....Kenosha, Wis.	229
WLAS	Central Radio Supply Co.....Hutchinson, Kans.	244
WLAT	Radio and Specialty Co.....Burlington, Iowa	360
WLAV	Electric Shop, Inc.....Pensacola, Fla.	254
WLAW	New York Police Dept.....New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station, Greencastle, Ind.	231
WMAB	Radio Supply Co.....Oklahoma City, Okla.	360
WMAC	J. Edward Page.....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co.....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.....Kansas City, Mo.	275
WMAK	Norton Laboratories.....Lockport, N. Y.	360
WMAL	Trenton Hdw. Co.....Trenton, N. J.	250
WMAN	First Baptist Church.....Columbus, Ohio	286
WMAP	Utility Battery Service, Inc.....Easton, Ohio	246
WMAQ	Chicago Daily News.....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute.....Auburn, Ala.	250
WMAW	Wahpeton Electric Co.....Wahpeton, N. D.	254
WMAW	Wahpeton Elec. Co.....Wahpeton, N. D.	360
WMAY	Kingshighway Presby. Church....St. Louis, Mo.	280
WMAZ	Mercer University.....Macon, Ga.	268
MNAC	Shepard Stores.....Boston, Mass.	278
WNAD	Oklahoma Radio Eng. Co.....Norman, Okla.	360
WNAL	R. J. Rockwell.....Omaha, Nebr.	242
WNAN	Syracuse Radio Telephone Co...Syracuse, N. Y.	286
WNAP	Wittenberg College.....Springfield, Ohio	360
WNAQ	Charleston Radio Elec. Co....Charleston, S. C.	360
WNAR	Rhodes, C. C.....Butler, Mo.	231
WNAS	Texas Radio Corporation and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Bros. Co.....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Tel. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzmann.....Fortress Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.....Yankton, S. D.	244
WNAY	Ship Owners' Radio Service.....Baltimore, Md.	360
WOAC	Maus Radio Co.....Lima, Ohio	266
WOAD	Friday Battery & Elec. Co.....Sigourney, Iowa	360
WOAE	Midland College.....Fremont, Nebr.	360
WOAF	Tyler Commercial College.....Tyler, Tex.	360
WOAG	Apollo Theatre.....Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.....Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Texas	385
WOAJ	Ervin's Electrical Co.....Parsons, Kans.	360
WOAL	Wm. Evans Woods.....Webster Groves, Mo.	286
WOAN	James D. Vaughn.....Lawrenceburg, Tenn.	360
WOAP	Kalamazoo College.....Kalamazoo, Mich.	360
WOAT	Boyd Martell Hamp.....Wilmington, Del.	360
WOAV	Pennsylvania National Guard.....Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Nebr.	526
WOAX	Franklyn J. Wolff.....Trenton, N. J.	240
WPAB	Pennsylvania State College..State College, Pa.	283
WPAC	Donaldson Radio Co.....Okmulgee, Okla.	360
WPAG	Central Radio Co., Inc.....Independence, Mo.	360
WPAH	Wisconsin Dept. of Markets.....Waupaca, Wisc.	360
WPAJ	Doolittle Radio Corporation...New Haven, Conn.	268
WPAK	No. Dakota Agricultural College...Fargo, N. D.	360
WPAL	Superior Radio & Telephone Co., Columbus, Ohio	286
WPAM	Awerbach & Guettel.....Topeka, Kans.	360
WPAP	Theodore D. Phillips.....Winchester, Ky.	360
WPAQ	General Sales & Eng. Co.....Frostburg, Md.	360
WPAS	J. & M. Electric Co.....Amsterdam, N. Y.	360
WPAT	St. Patrick's Cathedral.....El Paso, Tex.	360
WPAU	Concordia College.....Moorhead, Minn.	360
WPAY	Bangor Radio Laboratory.....Bangor, Me.	360
WPAZ	John R. Koch.....Charleston, West. Va.	273
WQAA	Horace A. Beale, Jr.....Parkersburg, W. Va.	360
WQAC	E. B. Gish.....Amarillo, Tex.	360
WQAD	Whitehall Electric Co.....Waterbury, Conn.	242
WQAE	Moore Radio News Station.....Springfield, Vt.	275
WQAF	Sandusky Register.....Sandusky, Ohio	240
WQAH	Brock Anderson Elec. Eng. Co., Lexington, Ky.	254
WQAK	Appel-Higley Electric Co.....Dubuque, Iowa	360
WQAL	Cole County Tel. & Tel. Co.....Mattoon, Ill.	258
WQAM	Electrical Equipment Co.....Miami, Fla.	283
WQAN	Scranton Times.....Scranton, Pa.	360
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	West Texas Radio Co.....Abilene, Tex.	360
WQAS	Prince Walter Co.....Lowell, Mass.	266
WQAT	Radio Equipment Corporation.....Richmond, Va.	360
WQAV	Huntington and Guerry, Inc....Greenville, S. C.	258
WQAW	Catholic University of America, Washington, D. C.	236
WQAX	Radio Equipment Co.....Peoria, Ill.	360
WRAA	Rice Institute.....Houston, Tex.	360
WRAD	Taylor Radio Shop.....Marion, Kans.	248
WRAF	Radio Club, Inc.....Laporte, Ind.	224
WRAH	Stanley N. Reed.....Providence, R. I.	231
WRAL	Northern States Power Co..St. Croix Falls, Wisc.	248
WRAM	Lombard College.....Galesburg, Ill.	244
WRAN	Black-Hawk Electric Co.....Waterloo, Iowa	236
WRAO	Radio Service Co.....St. Louis, Mo.	360
WRAV	Antioch College.....Yellow Springs, Ohio	242
WRAW	Horace D. Good.....Reading, Pa.	238
WRAX	Flexon's Garage.....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation.....Scranton, Pa.	280
WRAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WSAA	B. S. Sprague Elec. Co.....Mariette, Ohio	360
WSAB	Southeast Mo. State College, Cape Girardeau, Mo.	360
WSAC	Clemson Agri. College....Clemson College, S. C.	360
WSAD	J. A. Foster Co.....Providence, R. I.	261
WSAH	A. G. Leonard, Jr.....Chicago, Ill.	248
WSAI	U. S. Playing Card Co.....Cincinnati, Ohio	309
WSAJ	Grove City College.....Grove City, Pa.	360
WSAL	Franklin Electrical Co.....Brookville, Ind.	246
WSAN	Allentown Radio Club.....Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co....Fall River, Mass.	254
WSAT	Plainview Elec. Co.....Plainview, Tex.	268
WSAW	Curtice & McElwee.....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WSAY	Irving Austin Chamber of Commerce, Post Chester, N. Y.	233
WSAZ	Chase Electric Shop.....Pomeroy, Ohio	258
WTAB	Fall River Daily Herald.....Fall River, Mass.	248
WTAC	Penn Traffic Co.....Johnstown, Pa.	360
WTAG	Kern Music Co.....Providence, R. I.	258
WTAH	Carmen Ferro.....Belvidere, Ill.	236
WTAJ	The Radio Shop.....Portland, Me.	236
WTAL	Toledo Radio and Electrical Co. Toledo, Ohio	252
WTAM	Willard Storage Battery Co....Cleveland, Ohio	390
WTAN	Orndorff Radio Shop.....Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	390
WTAQ	S. H. Van Gorden & Sons.....Osselo, Wisc.	226
WTAR	Reliance Electric Co.....Norfolk, Va.	226
WTAS	Charles E. Erbstein.....Elgin, Ill.	275
WTAT	Edison Elect. Ill. Co.....Boston, Mass.	244
WTAU	Ruegy Battery & Elec. Co.....Tecumseh, Nebr.	360
WTAW	Agricultural and Mech. College, College Station, Tex.	254
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill.	226
WTAZ	Thomas J. McGuire.....Lambertville, N. J.	283
WWAB	Swern Hoenig & Co.....Trenton, N. J.	226
WWAC	Sanger Brothers.....Waco, Tex.	360
WWAD	Wright & Wright, Inc.....Philadelphia, Pa.	360
WWAE	Alamo Dance Hall.....Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAH	General Supply Co.....Lincoln, Nebr.	360
WWAO	Michigan College of Mines....Houghton, Mich.	244

Canadian Broadcasting Stations

CKY	Manitoba Telephone System.....Winnipeg, Manitoba	
CFAC	Radio Corporation of Calgary, Ltd...Calgary, Alberta	
CFCA	Star Publishing and Printing Co., Toronto, Ontario	
CFCB	Marconi Wireless Telegraph of Canada, Ltd., Vancouver, B. C.	
CFCD	Canadian Westinghouse Co., Ltd. Winnipeg, Manitoba	
CFCE	Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia	
CFCF	Marconi Wireless Telegraph Co. of Canada, Ltd., Montreal, Quebec	
CFCH	Abitibi Power and Paper Co., Ltd. Iroquois Falls, Ontario	
CFCI	Motor Products Corporation.....Walkerville, Ontario	
CFCN	W. W. Grant Radio, Ltd.....Calgary, Alberta	
CFCX	The London Advertiser.....London, Ontario	
CFPC	International Radio Development Co. Fort Frances, Ontario	
CFTC	The Bell Telephone Co. of Canadia....Toronto, Ontario	
CFUC	University of Montreal.....Montreal, Quebec	
CFVC	Roy Russell Brown.....Courtenay, British Columbia	
CFVC	Victor Wentworth Odium.....Vancouver, B. C.	
CFZC	Canadian Westinghouse Co., Ltd.....Montreal, Quebec	
CHAC	Radio Engineers, Ltd.....Halifax, Nova Scotia	
CHBC	The Albertan Publishing Co.....Calgary, Alberta	
CHCA	Radio Corporation of Vancouver, Ltd., Vancouver, B. C.	
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ontario	
CHCC	Canadian Westinghouse Co., Ltd., Edmonton, Alberta	
CHCF	Radio Corperation of Winnipeg Ltd., Winnipeg, Mantioba	
CHCQ	The Western Radio Co., Ltd.....Calgary, Alberta	
CHCS	London Radio Shoppe.....London, Ontario	
CHCX	B. L. Silver.....Montreal, Quebec	
CHCZ	The Globe Printing Co.....Toronto, Ontario	
CHFC	John Millen & Sons, Ltd.....Toronto, Ontario	
CHIC	Canadian Westinghouse Co., Ltd....Hamilton, Ontario	
CHOC	Canadian Westinghouse Co., Ltd....Vancouver, B. C.	
CHVC	Metropolitan Motors, Ltd.....Toronto, Ontario	
CHXC	J. R. Booth, Jr.....Ottawa, Quebec	
CHYC	Northern Electric Co.....Montreal, Quebec	
CJBC	Dupuis Frères.....Montreal, Quebec	
CJCA	The Edmonton Journal, Ltd.....Edmonton, Alberta	
CJCB	James Gordon Bennett.....Nelson, British Columbia	
CJCD	T. Eaton Co., Ltd.....Toronto, Ontario	
CJCE	Vancouver Sun Radiotelephone, Ltd., Vancouver, B. C.	
CJCF	News Record, Ltd.....Kitchener, Ontario	
CJCG	Manitoba Free Press Co., Ltd....Winnipeg, Manitoba	
CJCH	The United Farmers of Ontario.....Toronto, Ontario	
CJCI	McLean, Holt & Co., Ltd....St. John, New Brunswick	
CJCN	Simons Agnew & Co.....Toronto, Ontario	
CJCS	Eastern Telephone and Telegraph Co., Ltd., Halifax, Nova Scotia	
CJCY	Edmund Taylor.....Calgary, Alberta	
CJGC	London Free Press Printing Co., Ltd., London, Ontario	
CJNC	Tribune Newspaper Co., Ltd.....Winnipeg, Manitoba	
CJSC	The Evening Telegram.....Toronto, Ontario	
CKAC	La Presse Publishing Co.....Montreal, Quebec	
CKCB	T. Eaton Co., Ltd.....Winnipeg, Manitoba	
CKCD	Vancouver Daily Province.....Vancouver, B. C.	
CKCE	Canadian Independent Telephone Co., Ltd., Toronto, Ontario	
CKCK	Leader Publishing Co., Ltd., of Regina, Regina, Saskatchewan	
CKCR	Jones Electric Radio Co.....St. John, New Brunswick	
CKCS	The Bell Telephone Co. of Canada...Montreal, Quebec	
CKCZ	Canadian Westinghouse Co. Ltd.....Toronto, Ontario	
CKKC	Radio Equipment and Supply Co.....Toronto, Ontario	
CKOC	The Wentworth Radio Supply Co....Hamilton, Ontario	
CKQC	Radio Supply Co. of London.....London, Ontario	
CKZC	Salton Radio Engineering Co.....Winnipeg, Manitoba	



World Wide Broadcasting

DX Reception Made Possible on Crystal Sets When Havana's Talk to San Francisco Is Broadcast in New York — 50 Million Fans Scattered Over the Country Listen to Hooked-up Broadcast and Telephone Stations

By C. S. Anderson

"YOUR audience is the wide, wide world!" sounded a voice that spanned the continent on February 8th, in a demonstration of the most advanced development of linked radio and wire telephony ever accomplished.

Twenty telephone and seven radio broadcasting stations reaching from coast to coast and from Providence to Havana, connected by five thousand miles of wire enabled General J. J. Carty, Vice-President of the American Telephone and Telegraph Company, from the Congress Hotel at Chicago, to speak to possibly the largest and most extensive audience man has ever addressed at any one time, and the conversation from the various stations to one another likewise went out on the air through the broadcast stations.

The "Roll Call" of stations comprising the trans-continental radio-telephone system consisted of broadcast stations WJAR, Providence, R. I.; WEAF, New York; WCAP, Washington, D. C.; WMAQ, Chicago; KLX, Oakland, Cal.; KPO, San Francisco; PWX, Havana, Cuba, and telephone stations at Sacramento, Calif.; Winnemucca, Nev.; Salt Lake City, Utah; Rawlins, Wyo.; Denver, Colo.; Garden City, Kan.; Newton, Kan.; Kansas City, Mo.; St. Louis, Mo.; Terre Haute, Ind.; Chicago, Ill.; Phoneton, Ohio; Pittsburgh, Pa.; Philadelphia, Pa.; Lynchburg, Va.; Charlotte, N. C.; Denmark, S. C.; Jacksonville, Fla.; West Palm Beach and Key West.

These stations were connected by five thousand miles of wire, one hundred ten miles of which traveled under sea, being at one point one mile below sea level, while out in Denver the line rose one mile above sea level. Two-way transmission occurred over this trans-continental system. Vacuum tube repeaters were an essential part of the equipment for the purpose of rejuvenating or strengthening the voice currents. The type of tube used is similar in operation to the amplifier tubes known to most radio fans. The total energy amplification was well over one hundred billion that of the modulated currents flowing over the line between Havana and San Francisco during the test.

The "Roll Calls," station conversations, musical entertainment, General Carty's speech, and the applause at the Chicago Bond Club Dinner were heard by BCL's throughout the entire country.

"Hello, Havana," said General Carty at Chicago.

"Hello, Chicago, this is Havana."

"Hello, San Francisco, this is Havana."

"Hello, Havana, this is San Francisco."

"Your audience is the wide, wide world," cut in General Carty, "be careful what you say," (laughter in Chicago).

"They burned witches for less," exclaimed J. G. Truesdell at WEAF, New York.

"Hello Havana, can't we have some music?" asked General Carty, and soon a violin solo from "Thaïs" came through the ether. "Home Sweet Home" was played on the chimes at San Francisco. Applause at Chicago came over the air strong.

At 11:11 Eastern Standard Time, General Carty asked San Francisco the time. "It is 8:11 here—fine balmy evening, temperature 62 degrees," came the reply. Right here some fans in less comfortable parts of the country dropped their "ear muffs" to look after the furnace and others got ready for bed.

"Taps" sounded by a San Francisco bugler ended the demonstration after General Carty had finished his brief speech predicting a world wide telephone system using a common language that would unite all humanity and—"A great voice out of the ether will proclaim Peace on Earth, Good Will to Men."

Amateurs Shake Hands Across Atlantic

J. F. Schnell and John Reinartz of America Talk with Leon Deloy in France

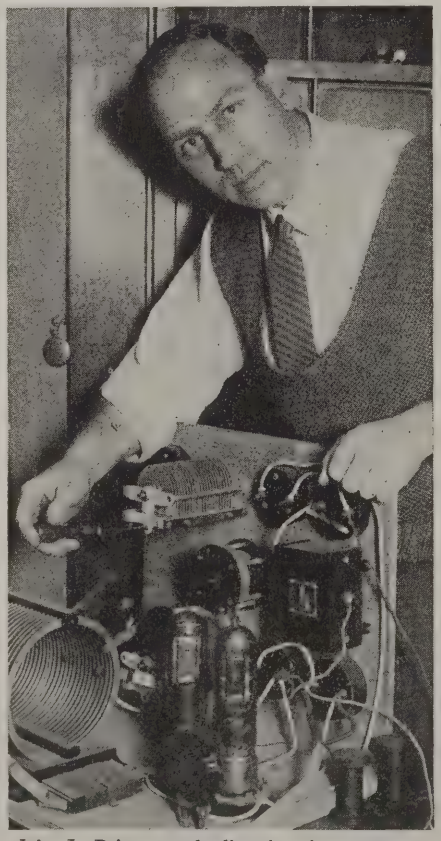
Receiving apparatus of the station in France that talked with American amateurs. Station French 8AB, owned by Leon Deloy, at Nice

IT was not chance that enabled two amateur radio operators, seated in their homes, to exchange messages across 3,500 miles of the broad Atlantic Ocean in the first successful two-way communication—making a world record and marking the greatest forward step in the history of short-wave radio since the first signal of an American amateur station landed in Ardrossan, Scotland, three years ago.

There is a big difference between turning on full power and blindly slamming away at a transmitter with the hope that one of several score listeners will pick up the signal miles away and the job of choosing from the hundreds and thousands of stations on the air the one that you want paricularly. That explains why the two-way communication between Monsieur Leon Deloy, of Nice, France, and two separate stations operated by F. H. Schnell, traffic manager of the American Radio Relay League, and John Reinartz, of South Manchester, Conn., was a deliberate effort requiring months of preparation.

The methods of the operators on either side of the Atlantic had to be worked out in painstaking detail the first time to prove that this seemingly impossible job could be done. After that it could be left to others to show, by following in the path they had blazed, that two-way radio code conversations could be carried on practically and efficiently between private citizens across the seas.

The remarkable feat was accomplished on the night before Thanksgiving when 1MO in Hartford, Conn., and French 8AB at Nice made the contact across the ocean and showed that it was entirely possible for one of the thousands of amateur transmitting stations in the United States to pick out and talk to one of the many hundreds in France and England—this while the other was sounding with the melody of thousands of CW transmitters and broadcast stations were hurling DX music over the continent.



John L. Reinartz, a leading American amateur experimenter, who communicated with French station 8AB

While we marvel at the mechanism of the automatic telephone that enables us to choose the right party out of a city of several hundred thousand by the simple turning of the dial, we cannot help also but stand in wonder at the medium that allows private conversation to be carried on through the air, despite the great volume of other messages that penetrate the ether.

It is impossible to describe fittingly the great amount of detail, the careful recording of time schedule, and the exact precision in the tuning of respective sets that made it possible for Monsieur Deloy to transmit on his key the brief "GM, OM," meaning "Good Morning, Old Man," in answer to the clear call "8AB fu 1MO" that came from America. It was early morning in France when that message was heard though it was exactly 10:30, Eastern Standard Time, Thanksgiving Eve, in Connecticut.

The receipt of that simple greeting from the darkness out over the ocean to the point where it was nearing daylight on the other continent carried with it a feeling that only an amateur could appreciate, and only a ham that was used to "boiled owl" practices that keep him at his key through long anxious hours could adequately express, for it meant realization of the dreams of all short-wave radio fans.

This brings us to the scene at amateur station 1MO, at Hartford, which marked the beginning of the transmission tests with Europe on that night after Mr. Schnell had obtained the sanction of the radio inspector of the first district to transmit on 100 meters.

For two nights in succession Schnell had listened to the pecular note of 8AB like a string of r's run together and just the suggestion of an (h) like r-h-r-r r-h-r-r in steady beat and on the previous night he had copied two complete messages so that his fingers fairly ached to grasp the key and hurl 1MO's loud bark into the air. He sat down in front of the transmitter and ran his fingers nimbly over the set, tuning it down to the proper 100-meter wave length.

This was at 9:25 and he listened for fully fifteen minutes before he heard

the French amateur's note calling "A1MO (the prefix A being for America) de F8AB, GM, OM, here messages." Number 3 read:

"Your cable establishing midnight schedule received this morning. I consider it as cancelled by your agreement to my message No. 2, sig. F8AB." At 9:38 this message was ended and Deloy sent:

"No. 4 A1MO, tomorrow will not be on at this time, pse listen at 0500 and transmit at 0515, sig. F8AB." The figures given represent the transmitting time schedule in Greenwich Mean Time. Not knowing, of course, whether these messages had been received in the United States, Deloy went on and repeated both of them over a second time, after which he stood by for about ten minutes and repeated them a third time. At exactly 10:27 he signed off calling A1MO, A2BY CQ de F8AB.

At the moment that the lid went off for the amateur quiet period for the benefit of broadcasting at 10:30, Schnell closed his antenna switch and grasped the key to test the result of many months of planning. Thousands of amateurs could understand his emotions.

"8AB fu 1MO" clicked out into the air and traveled across to France where it struck and vibrated at Deloy's receiving antenna at Nice.

"ARR," he went on "messages received signals QSA." He called and repeated until 10:37 and a moment later the silence broke with:

"A1MO de F8AB rr QRK. Your signals QSA vy one foot from phones on Grebe. FB OM. Hearty congratulations."

Two-way communication between the continents was thus established, but to the great surprise of both operators

F. H. Schnell whose receiver picked up French station

Dave Tyneberg, a New York boy, who got France on his receiver during the recent trans-Atlantic tests

it was not only for a brief second or two to give them credit for the accomplishment and nothing more. Instead, steady and reliable communication was continued for two hours.

"This is a fine day," called Deloy, joyously it appeared. "Pse QSL No. 1 and No. 2."

"O. K. FB QSA (meaning signals loud) I have messages. Are you ready to receive them?"

This was 10:50 and the French amateur came back. "Sure, go ahead with messages, words twice." As he was signing off, Schnell heard him call A1XAM, the station operated by John Reinartz at South Manchester, Conn., only a few miles away, saying: "Pse QRX until after A1MO."

"8AB fu 1MO" called Schnell and he transmitted message No. 1 from America address to General Ferrie, director of telegraphs for the French government, which was acknowledged at 11:06 and read as follows:

"America greets you for the first time by amateur radio across the ocean on 100 meters."

The message was signed A. R. R. L.

By this time Kenneth B. Warner, secretary of the A. R. R. L., and joint owner of 1MO, had come in at Schnell's request and the latter told Deloy that "KBW" wanted to talk with him. Warner took the key and talked with the French amateur for several minutes, then he sent a formal message No. 2 address to Dr. Couret of France.

It was considered remarkable that the transmission was not fleeting and "spotty" as might be supposed with the first two-way code "talks" across the ocean, but wholly reliable as though the two stations engaged in the tests were not more than a few blocks away. In fact, Schnell and Warner both were amazed at the consistency with which the conversations were being carried on and they believe it gave every indication that two-way amateur radio talks would not only become a common thing in a very short time, but that operators on either continent can maintain very satisfactory communication.

No one was more astonished by the result than Schnell, who had been working with Deloy for weeks to make this hour possible. Highly enthusiastic he was determined to carry on the conversation as long as he could. With visions of a great amateur radio "loop" by which messages might be sent from France to Hartford, from thence over the continent to Santa Catalina Island on the Pacific Coast and finally, over the Canadian mountains to the MacMillan arctic expedition at Refuge Harbor, Greenland, he grasped the key once more and asked Deloy to send a message to WNP. F8AB promptly complied with this request, but 1MO's operator failed to copy two words of the North Pole radio message.

Deloy then called 1XAM and asked for his location as apparently he did not know, or had forgotten it was Reinartz's station. Then Schnell stood by for a few minutes while 1XAM worked the French amateur.

At 12:22 Schnell sent Deloy's call signing his own, and when he had received an acknowledgment, he said that he had missed part of the last message and asked whether he could get it from 1XAM or if Deloy would repeat the text of the message again. F8AB repeated as requested, and apparently he was having trouble, for the added quickly QSL k and finished at 12:35 A. M. after making a schedule for the following night.

(*Continued on page 78*)

Principles of Design—Construction described in detail —How to operate properly

The Wireless Age 3-Tube Set

Our 1924 Spring Model, One Stage of Tuned R. F. A. Impedance Coupled to Crystal Detector and Two Steps of A.F.A.

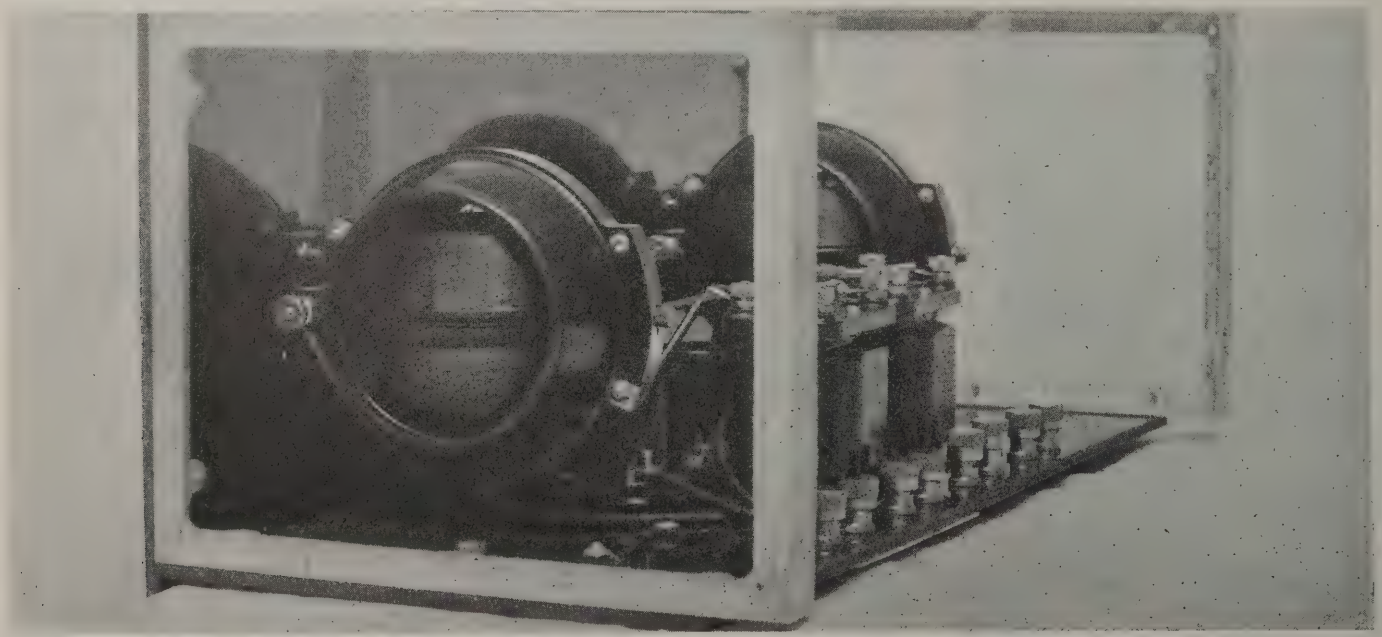
By John R. Meagher

NOTE—Certain patent owners permit amateurs to make up their own radio devices for their own use and not for sale. Relying on this policy this article gives suggestions to aid amateurs in their experimentation, but no license under patents is to be inferred from the publication of these suggestions. The license rights exist only through the generosity of the patent owners and if any owner should object, the amateur should refrain from using the particular invention involved.

An Easy Set to Tune — Gives Excellent Results — Smooth, Positive Control

THE circuit for this issue has three tubes and a crystal detector. The first tube is coupled to the detector through a tuned impedance—in this case a variometer—as shown in the simple circuit.

The action is somewhat as follows: The antenna and grid circuit are each tuned to resonance with the frequency of the incoming energy which is impressed on the grid of the tube and reproduced in magnified form in the plate circuit through the amplifying characteristics of the tube. The variometer in the plate circuit is also tuned to this frequency and then presents an infinite impedance so that the radio frequency energy cannot go through, but is shunted off to the detector and to the plate of the tube. The detector affords rectification and the signals are made audible in the headset. The choking effect of the variometer permits the small plate-grid capacity to act as an easier path for the radio-frequency energy than does the variometer, so part is transferred back to the grid and the current or "tube" oscillates. Self-oscillation of this sort is not desirable so an adjustable resistance is included in the grid return lead. Free oscillations depend (for one thing) upon the resistance of the grid circuit. This method of "stabilizing" is just as good as any and better than most schemes because manipulation of the "stablilizer" does not materially affect the wavelength adjustment.



The simplicity of the receiver is evident in this end view. Note how cast aluminum frames are used to support the front and sub-panels

Another good point about this circuit is the coupling between the radio frequency amplifier and the detector. We know of nothing better with a single control.

In addition, almost everyone will admit that a crystal rectifier, though a trifle troublesome, nevertheless seems to give better results in clarity of signal than a hard tube or an improperly adjusted gas content detector.

Now to this simple circuit all we have added is a regular two stage amplifier so that we have:

One stage of tuned radio frequency amplification for distance and selectivity.

One crystal detector for clarity and —two stage of audio frequency amplification for loud speaker volume.

The set itself is easy to make; the parts do not cost much and the appearance is rather good as the illustrations show. There are but two main controls or "station selectors" and one stabilizer (the Bradleystat) which operates very smoothly. The range with this set is about the same as a well designed and carefully operated regenerative detector and two step amplifier.

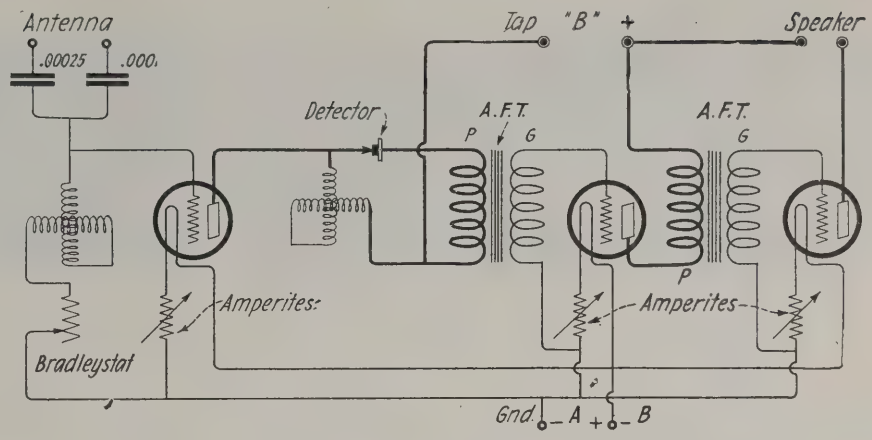
"But why a Bradleystat—it hasn't high enough resistance, has it?" queried our "C. E."

"Oh, yes it has. That's something we just found out. They average something like 100 ohms at maximum and of course they give such a smooth variation of resistance that they are ideal for control of regeneration."

"Now, about the arrangement," we said. "Let's use a nice long Radion front panel with the variometer mounted at each end and the sockets and transformers in between. That will give us good separation and a nice layout. Imagine how *spiffy* it will look if we use two Accuratune dials against a neat black panel!"

CONSTRUCTION

Many of the following notes have been extracted from the "C. E.'s" notebook which he entered while actually constructing the revised set.



Circuit diagram of The Wireless Age three-tube receiver using one step of R. F. A., crystal detector and two steps of A. F. A.

Secure all the parts first—have everything ready so when once started the work can progress smoothly. Here is a list:

MATERIALS

Again we caution the builder to purchase only good apparatus and to avoid use of anything that is all questionable. As usual, we indicate the make of each part, but many other manufacturers have equally good products.

Two variometers (Paragon). In place of variometers one may use tuned circuits consisting of .0005 mfd. (23 plate) variable condensers shunted across coils of 50 turns of No. 30 D. C. C. wire wound on 3-inch forms of thin material. Each coil may be mounted on the back of its tuning condenser. They should, however, be placed at right angles to each other on the panel.

This 3-tube receiver is going to attract the same wide-spread popularity won by the Wireless Age Uni-control Receiver by the same designer Published in an Earlier Number.

We have received a large number of appreciative letters about the Uni-Control.

Three Na-ald No. 400 standard tube sockets. The laminated double contacts and the careful design makes these sockets especially satisfactory.

Three 1-A Amperites for filament control of all three tubes. We removed the clips from the bases of these and screwed the clips to the sub-panel as shown in the photographs and explained in the text.

One Bradleystat for control of free oscillation of the R. F. A. tube. This make is specified because it is the only one we know of that has high enough resistance at the maximum position to be effective in this circuit. Of course wire wound resistances of about 100 ohms may be used, but the Bradleystat provides a smoother control—and this is a very important factor in good operation.

One Bradleyswitch to break and complete the filament circuit.

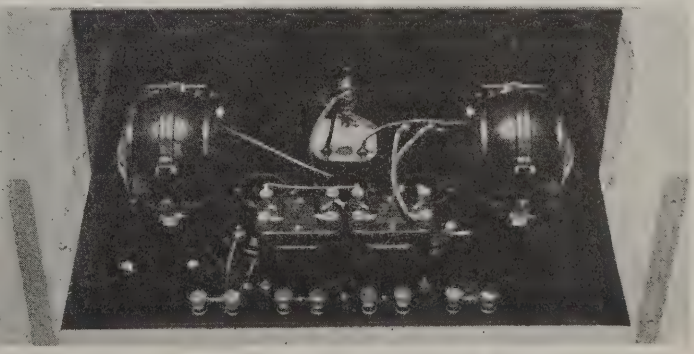
Two Kellogg transformers, ratio 4½ to 1.

Two Accuratune dials: Read the instructions packed with each of these before using.

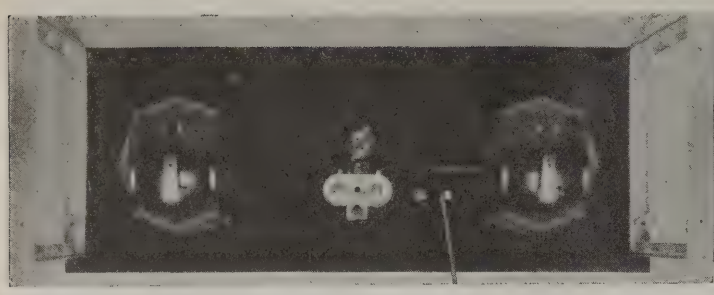
Two Quinby aluminum frames for 7-inch panels: This method of mounting enables one to add other panels from time to time and yet retain a uniform appearance.

Two Radion panels 7x18x3/16-inches. These are selected because

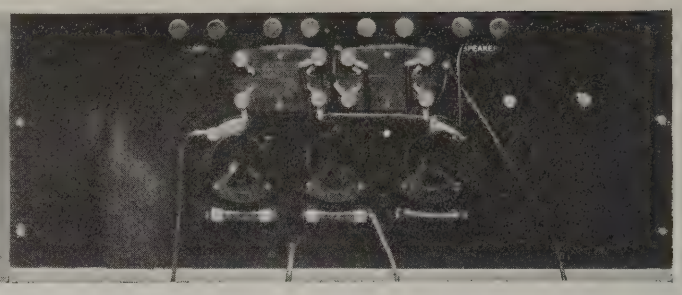
Top view—Through the use of straight direct connections run, in cambric tubing, wiring may be easily and quickly accomplished



Rear view—The Bradleystat in the center is not used as a rheostat for filament control, but as an adjustable grid circuit resistance to control self oscillations of the R. F. tube



Only the variometers, the rheostat and the filament battery switch are mounted on the front panel



The small cartridges in front of the tube sockets are ballast resistances for controlling the current in the filaments. View shows sub-panel on which are mounted the A. F. transformers, tube sockets, binding posts and the filament resistances

they are so easily worked and also because they are good electrically.

One crystal detector with a good mineral and a positive, firm adjustment. Do not mount a "fixed" crystal detector in the set unless it has proved satisfactory.

One .0001 mfd. Dubilier fixed condenser.

One .00025 mfd. Dubilier fixed condenser.

Eight Eby binding posts.

Three strips of black cambric tubing.

Four strips of square tinned bus bar wire.

Screws for mounting the sockets, variometers, transformers, etc.

Accessories

Three UV 201-A (C 301-A) tubes.

One 6-volt storage battery.

Two 45-volt "B" batteries.

One loud speaker.

One aerial; single No. 14 wire at least 100 feet in length, carefully insulated with porcelain at all points of suspension.

One good ground.

In the construction only those tools shown on page 59 of the January issue of The Wireless Age were used.

The Panels

Radion panels are specified, but of course bakelite, formica or other material may be used; the latter two are less pliable than Radion so they will make a more solid assembly. However, the first is much easier to drill. In the drilling care must be taken that the polished surface is not scratched or marred in any way.

First lay out and drill the holes for mounting both panels to the Quinby frames: These frames are 6⅕-inches high and in this set they are fitted flush with the sides and top of the front panel. However, we would suggest that they be moved in ¼-inch from each side and the same distance from the top so that ¼-inch wooden sides and top may be fitted to them in place of a cabinet. The sub-panel may be mounted inside the frame on the upper portions of the lower sides (instead of the lower portions). This will look better. We made it as shown for a special reason.

Having assembled the panels and frames, arrange the separate parts on the sub-panel, moving them about until there is sufficient clearance all around; using the general layout indicated in the photographs.

The filament terminals of the tube sockets are brought through the sub-panel by substituting longer screws for the ones on the sockets. The longer screws should extend about ⅜-inch below the bottom of the sockets. Mount the sockets with the filament terminals facing the front panel.

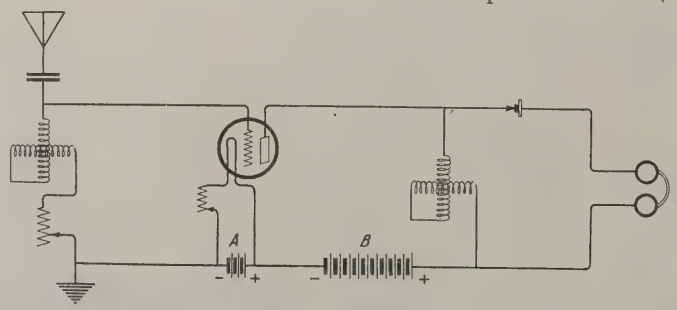
The clips are removed from the mounting bases of the Amperites and the second bent-over portions are cut off.

Mark the location of the mounting holes and drill—after which the panels may be engraved. Ours were done at W. W. Ackerman's 38 Park Place, New York City.

Re-assemble the panels, frame and apparatus.

Wiring

As the screws for the Amperite mountings and the filament terminals of the sockets extend through the sub-panel, the filament circuit may be wired on the bottom of the sub-panel, leaving only two leads up to the switch. The rest of the circuit is exceptionally long, and using No. 18 wire run in thin black cambric tubing, very little time need be spent on this section. Special attention should be paid to the return leads from the grids of the audio frequency amplifying tubes; they are connected to the negative side of the "A" battery.



Simple wiring diagram of The Wireless Age set without the audio amplifiers

The Amperites and battery switch will rarely cause trouble.

Then with a testing outfit composed of a dry cell and headset connected in series so that one headset lead and one battery connection are free to act as test terminals, test the transformer windings, the connections and the variometers (or fixed coils) for continuity of winding. And, of course, if everything is not O. K., fix it by repairing or replacing the faulty part. Test also the fixed condensers for short circuits. It would be a good plan to test the parts before the assembly, but as the makes shown are usually tested at the factory, this is not absolutely necessary. However, accidents can happen while wiring and for that reason it is well to test the completely wired set.

Operation

Use a good ground, a good aerial, good batteries connected properly and make sure that the tubes are in perfect condition.

In operating, one may consider the left hand variometer as the primary circuit; the right hand one as the secondary and the rheostat as the regenerative control, or better still, the two large dials as "wavelength selectors" and the Bradleystat as "volume control."

The first or left hand control is very critical, the other is not, but should be in approximate resonance with the first for best results. The Bradleystat, when screwed all the way in by turning the knob clockwise, permits the set to oscillate, but as this knob is turned counter-clockwise so that the ressistance increases, a point is reached at which the receiver stops oscillating; at this point loudest signals are secured.

As the aerial is part of the grid tuning circuit it should be erected so as not to sway. Under this condition the dials may be calibrated and stations picked up in much the same fashion as with a Neutrodyne.

Make Your Own Loud Speaker

By Max Abel

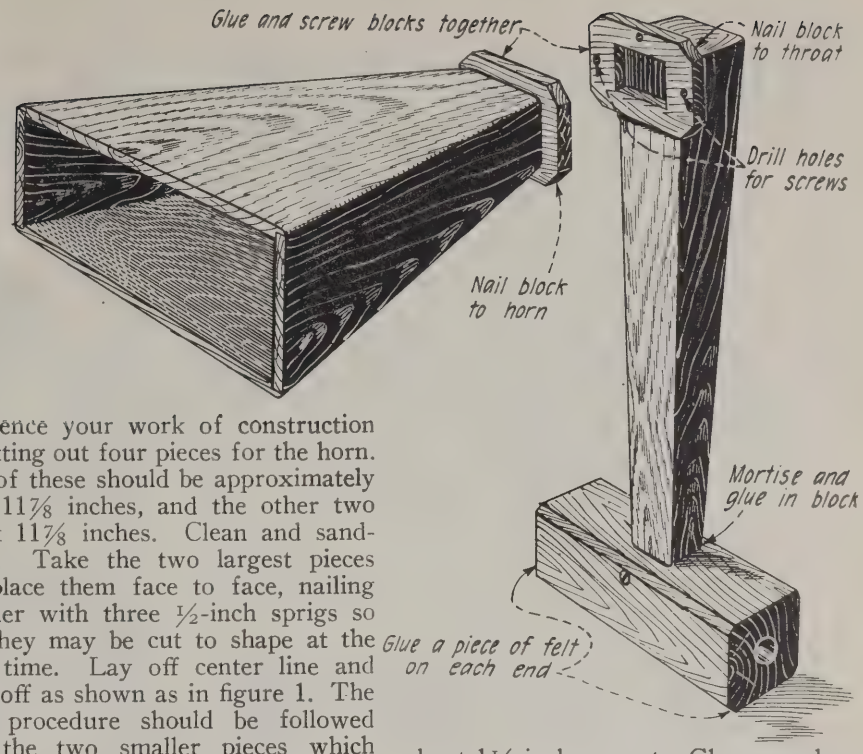
The horn described in this article, when used in connection with a pair of Western Electric 194W telephones, has carried a broadcast sermon to a distance of 800 feet from the set.

ONE of the greatest problems in connection with any of the many types of loud speakers, home-made or otherwise, is that of faithfully reproducing pure musical tones, without distortion or vibration. Metallic horns in many cases vibrate badly, and make the music "tinny" while others that eliminate this evil do not have distance-carrying properties. The loud speaker described herein has been tested under all sorts of conditions by a dozen different operators with remarkable results. The long throat and horn give a lower and more pleasing pitch than most loud speakers. Of course a great deal depends on the telephones used, the better the phone the greater will be the results attained.

A good hard wood should be selected out of which to make the speaker—3 linear feet of quarter-inch baywood, 16 inches wide, is all that is necessary. If you cannot get baywood, walnut or oak will do. But be sure it is dry and smooth, as this will save a lot of work later on. Baywood is the best because it is not only dry, but easy to work.

Having this nice piece of wood, you commence your work of construction by cutting out four pieces for the horn. Two of these should be approximately 8¼ x 11⅞ inches, and the other two 4¼ x 11⅞ inches. Clean and sandpaper. Take the two largest pieces and place them face to face, nailing together with three ½-inch sprigs so that they may be cut to shape at the same time. Lay off center line and mark off as shown as in figure 1. The same procedure should be followed with the two smaller pieces which make up the sides of the horn as shown in figure 2. Saw out these pieces to marks and be sure in cutting to cut straight and true. If the edges are rough use a sharp block plane on them and bring edge to line and square with face. Figures 3, 4 and 5 can be nailed together and cut to pattern and finished in like manner.

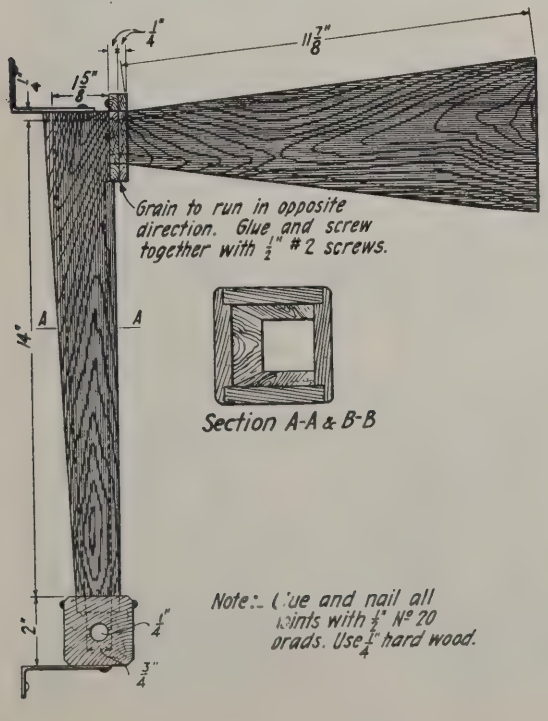
The pieces shown in figure 1, as well as those in figures 3 and 4 should have a rabbet cut on the long edge ⅛-inch deep by ¼-inch wide. Care should be used to get a neat joint. When this is finished try the pieces together and ascertain if the pieces fit. Start your brads so that you can nail the sides on. These brads should be spaced about 1½ inches apart. Glue one edge and nail large piece to sides of smaller ones. Then nail other side on, turn over and nail bottom of horn to sides. If not quite square, a little pressure on the corners will true it. Nail the throat the same way, but before nailing cut 1¾ inches off as shown in figure 3 to allow for block.

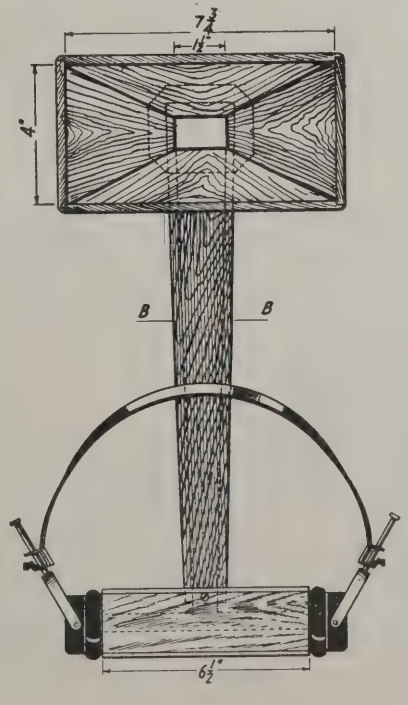

Glue and screw blocks together
Nail block to throat
Drill holes for screws
Nail block to horn
Mortise and glue in block
Glue a piece of felt on each end

The next step is the construction of the two connecting blocks. The best procedure is to nail two pieces together, cross grain, with short sprigs and cut out as one piece. Mortise out center hole, being careful not to split—cut from one side half way, and then turn over and cut from the other side. When completed the measurement will be 2½ x 3 inches.

When the glue is thoroughly dry and set, square the small end of the horn and glue and nail on one of the small blocks. See figure 6, No. 3.

Clean and sandpaper the throat sections. Fasten a three-cornered block into the throat at the top. Drill holes in connecting block (figure 6, No. 1) and fasten block to throat with glue and nails, as shown in figure 6, No. 2. After all is clean and dry, glue and screw the horn to throat (figure 6, No. 4). Make the telephone block out of a piece of mahogany about two inches square by 6½ inches long. Bore a half-inch hole from end to end (bore half way from one end and then from the other). Then bore a three-quarter-inch hole from the top so as to meet the longitudinal boring. Mortise out to fit the throat about ⅜-inch deep, glue and put in a couple of small screws to hold fast. Glue a thin piece of rubber or felt on each end of the telephone block as buffers for the phone ear-pieces.


Grain to run in opposite direction. Glue and screw together with ½" #2 screws.
Section A-A & B-B
Note:- Glue and nail all joints with ½" No 20 brads. Use ¼" hard wood.



Improve Your Set

By Following These Instructions

Proper Arrangement of Parts and Addition of Units Will Give Wonderful Results

By

Edgar Terraine Johnstone

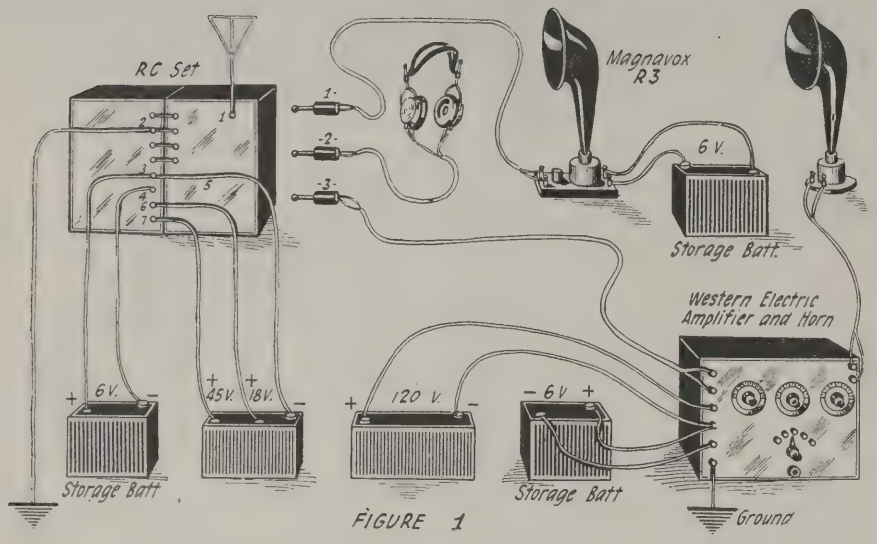


FIGURE 1

THE wise man is he who does the best he can with what he has. Thousands of radio fans—to make a moderate statement—have sets that do not satisfy or no longer satisfy when compared with the fine new sets which one's friends are always chirping about. And these people fail to realize what can be done with ease and at small expense to improve their own sets. Many of the methods of improvement I am going to give here out of my own successful experience apply quite generally, but to give specific help I am going to choose my old RC set as an example. The RC receiver has been a popular set and many of my readers probably have one.

Let me tell you, don't discard it. I have been able to get wonderful results with mine by making a few additions which I will tell you how to make.

Figure 1 gives you a very clear sketch of the RC receiver arranged for most efficient operation. The antenna is connected to post 1, the ground to post 2. The 6-volt 80-ampere hour "A" storage battery is connected to posts 3 and 4. It is absolutely necessary that the polarity be correct as shown in the drawing; positive to 3 and negative to 4. The negative connection of the 45-volt "B" battery is also to post 3—designated by No. 5. Eighteen to twenty-two and one-half volts on the detector tube plate to post 6 and the positive 45-volt battery lead to post 7.

Before going any further, and in order to give you a better understanding of the outfit, reference should be made to figure 2, where the elementary circuit of the RC is shown. This is nothing more than a single circuit receiver and is made clearer in the drawing 2a. In both cases the amplifier circuits are omitted for the sake of simplicity.

Clicks in the receiver or horn when operating the regenerative (tickler) handle can be eliminated by turning the tickler handle three-quarters (on) and operating the filament rheostat controlling the detector tube. In fact, this is true for most any receiver and is desirable because it offers a degree of selectivity not obtainable otherwise.

If this arrangement does not entirely satisfy you, then the circuit shown in figure 3 can be resorted to. This is not recommended, unless the variometer is properly shielded. If it is not shielded body capacity will be present and prove very annoying while tuning the variometer.

If the foregoing instructions are carried out, very good results will be obtained without the addition of external units such as variometers, etc. The RC is very compact and complete in every detail and requires no additional parts to assist regeneration. There is not a station in existence (of any consequence) that has not been received at my home in New Orleans with the RC receiver.

A loop antenna can be used with the RC receiver very efficiently. For the benefit of those desiring to duplicate my work along these lines I have shown in figure 4 the connections for the loop and RC receiver. Stations

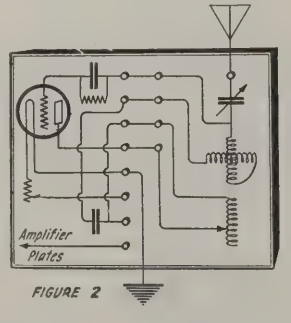


FIGURE 2

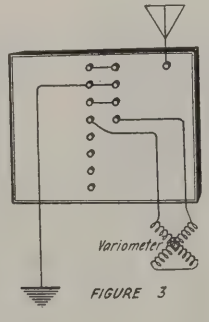


FIGURE 3

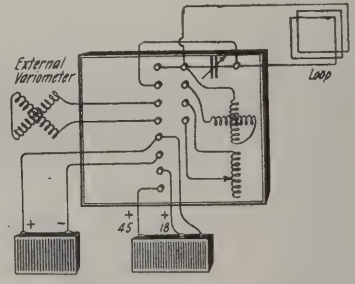


FIGURE 4

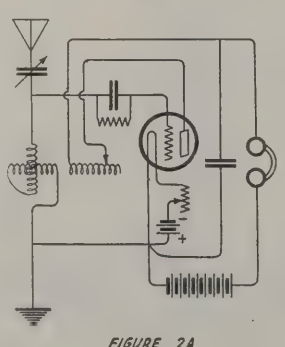


FIGURE 2A

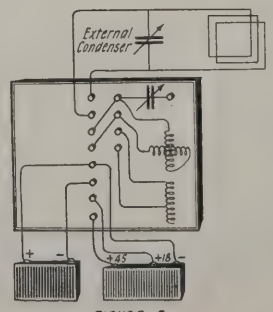


FIGURE 5

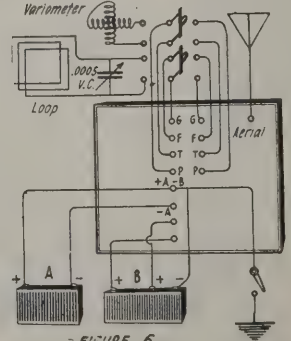


FIGURE 6

were picked up and their concerts enjoyed averaging from six to eight hundred miles distant. The variable condenser inside the tuning unit is shunted across the leads of the loop. Tuning is accomplished by turning the same handle formerly employed for tuning the RC receiver. The leads of the loop are then brought to the input of the detector-amplifier unit. In this case it is necessary to make use of an external variometer for regeneration—(see figure 3). It is also possible to use an external variable condenser across the leads of the loop and use the variometer (in the tuning unit) for regeneration. This is clearly shown in figure 5. Here the variometer is connected in the plate circuit of the detector unit and regenerative amplification accomplished by turning the large dial on the front of the RC receiver.

Having obtained such wonderful results from both the overhead antenna and the loop, I decided to arrange the set together with both types of antenna so that I could change from one to the other without very much trouble. With two double-pole double-throw switches this was easily accomplished. The entire circuit is shown in figure 6 where the four top posts of the detector-amplifier side of the set are connected to the blades of the switches. On the right hand side, the four posts of the tuning unit are connected to the jaws of the switches. When the switches are thrown simultaneously to the right they connect the RC set in the usual manner. When thrown together to the left the variometer is connected in the plate circuit of the detector; while the loop with its tuning condenser is connected to the input of the detector-amplifier unit.

The tuning condenser and variometer (both external) should be placed in a separate cabinet, special care being exercised to thoroughly shield the instruments not only to prevent body capacity, but from each other.

The above arrangement can easily be duplicated by any one in possession of this type of receiver by merely adding a loop, one variometer, one condenser and two double-pole double-throw switches.

RT Coupler Unit

So many new broadcasting stations went into operation since the date I purchased my receiver that it became next to impossible to tune in any particular station without interference. This of course was not the fault of the receiver. Something had to be done, and, as expected, the new RT Coupler was developed and placed on the market. I lost no time in obtaining one of these units and have received very beneficial results from its addition to the circuit.

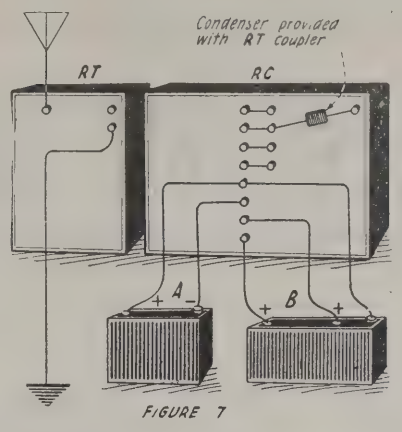
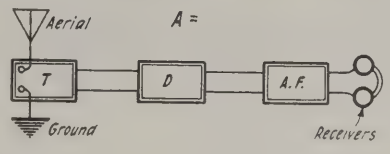


FIGURE 7



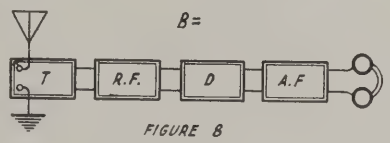


FIGURE 8

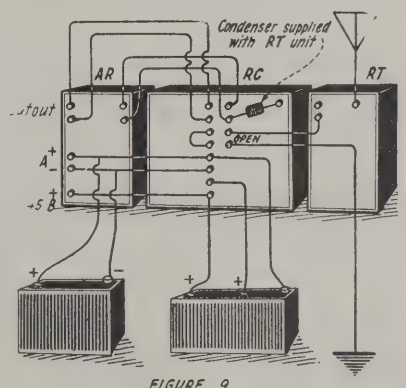


FIGURE 9

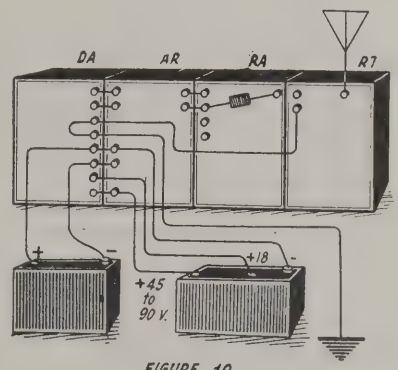


FIGURE 10

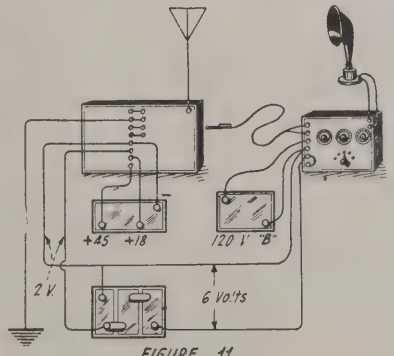


FIGURE 11

Radio Frequency Unit

The long waited for—and much talked about—radio frequency amplifier was next available for those owning RC receivers. This was added to the collection. This instrument, as I understand it, permits amplification of the extremely feeble waves which are being picked up, but which are not strong enough to operate the detector. They are then amplified by the two stages of audio frequency amplification. A very simple graphical illustration is given in figure 8.

At (a) we have the ordinary system employed in the RC receiver. First, a tuner T, then a detector D, and finally an audio frequency amplifier AF. Signals that are too weak to operate the detector will not be heard in the telephones no matter how many stages of amplification are added after the detector.

At (b) the new system is shown, employing the three-stage radio frequency unit with the RC receiver. First, the tuner T, then the three-stage radio frequency amplifier RF, which builds up the extremely weak signals to a value which permits operation of the detector. This is in turn amplified by the audio frequency amplifier AF.

Figure 9 shows the AR unit properly connected to the RC receiver to which has already been added the RT coupling unit. The best arrangement of the RC and new units is shown in figure 10 where the RC receiver is divided into the two component units, namely, RA and DA. RA (tuner) and DA (detector and amplifier) cabinets can be purchased and the two units after being removed from the RC cabinet can be installed in the individual cabinets. This permits the

By connecting the RT coupler unit in the aerial ground circuit and inductively coupling it to the RC tuning unit—as shown in figure 7—great selectivity is obtained. This unit converts the RC single-circuit receiver into a double-circuit type.

A small fixed condenser is provided with the RT coupling unit and is connected across the aerial and ground binding posts of the RC receiver. This condenser tends to replace the aerial ground connections formerly applied directly to the receiver and keeps the tuning on approximately the same divisions on the dial.

There are no connections to be changed other than removing the aerial and ground; connecting same to the RT coupler as shown, and to connect the fixed condenser in its position on the RC receiver. (Aerial-ground.)

(Continued on page 80)

SOME

Practical Radio Hook-Ups

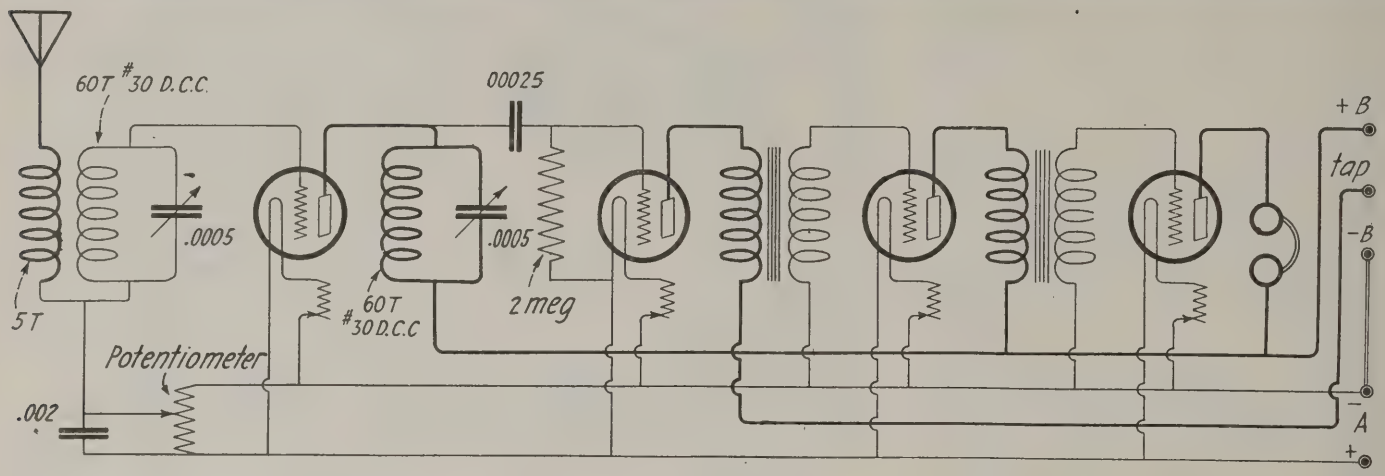


FIGURE 1

Figure 1—One step of tuned impedance R.F.A. and two-step A.F.A.—Long distance reception is easy with this easily constructed four-tube receiver using one step of tuned impedance coupled R.F.A.

The antenna coupler is wound on a thin 3" form with number of turns specified. Primary may be wound directly over the secondary near the filament end. Tuned impedance coil also wound on 3" form. Both forms may be mounted on their separate 23-plate tuning condensers, but should be placed at right angles to each other.

Use UV-201A's throughout or a UV-200 as detector.

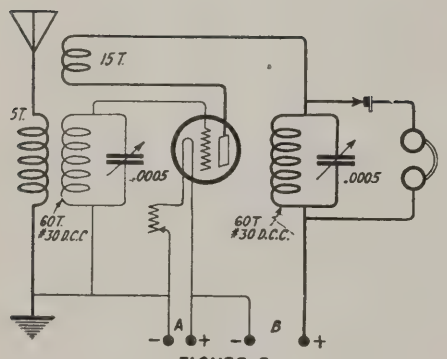


FIGURE 2

Figure 2—The "Superdyne" with a crystal—The "Superdyne" in modified form. Using a crystal detector with one stage of R.F. amplification; coupling of the tuned impedance type with reversed magnetic feedback to kill self oscillation.

An old coupler form may be used for this set. Rewind the rotor with 15 turns; the stator with 60 and over the stator wind a primary of 5 turns.

Use any vacuum tube. Reception will be found clear and distinct.

Figure 3—One-step R.F., crystal detector and one-step A.F.—A mighty fine portable receiver may be built up using this circuit with two UV-199 tubes. The Bradleystat provides an extremely smooth control of self oscillation. With a good aerial reception up to 2000 miles may be expected with this receiver under favorable conditions.

Wind both transformers on thin 3" forms and mount them at right angles to each other on back of their separate tuning condensers.

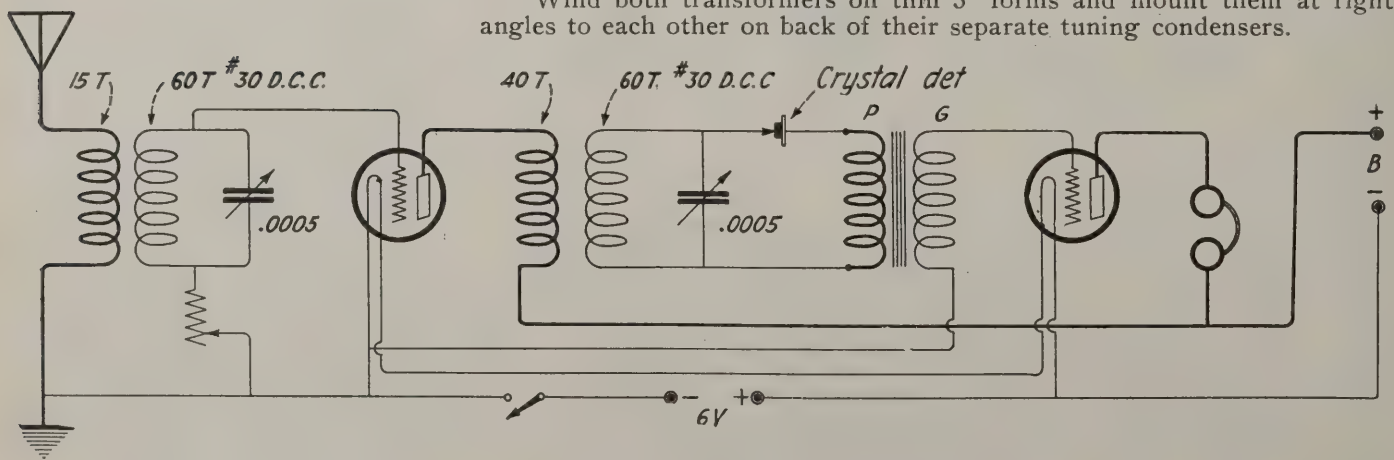


FIGURE 3

FOR THE

"Build-Your-Own" Fan

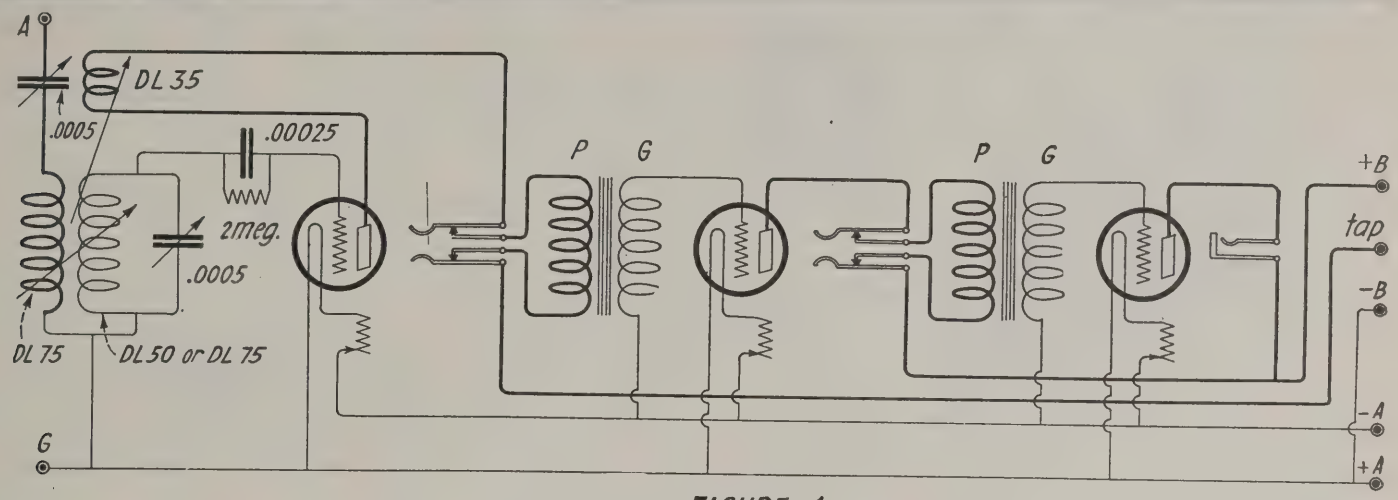


FIGURE 4

Figure 4—Standard three-coil set—The old reliable three-coil set that is still breaking DX records.

Honeycomb, duolateral, spider web, single layer, Curkoids and any suitable coils may be used. Be sure connections to them are electrically perfect. With the coils wound in the same direction the grid and plate should be connected to corresponding points on the tickler and secondary coils.

If a UV200 detector is used, a carbon pressure rheostat will enable one to secure maximum results. Use good variable condensers.

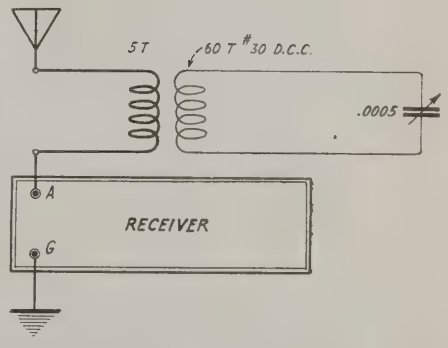


FIGURE 5

Figure 5—Inductively coupled wave trap—Tuning this wave trap doesn't seriously affect the adjustment of the receiver, but it does cut down interference from any one particular station.

The coils are wound on a thin 3-inch form and the form is mounted on the tuning condenser. Keep the coils away from the receiver in order to reduce the coupling.

The trap is tuned to the frequency of the interfering station and the receiver is tuned to any other station that one wishes to hear.

Figure 6—Four-tube (UV-199) loop receiver—A selective long distance loop receiver of the "Unicontrol" type. The feature about this set is the simplicity of construction and operation and the extremely low filament current, only .12 amperes.

See the December, 1923, issue of The Wireless Age for more detailed information about a similar set.

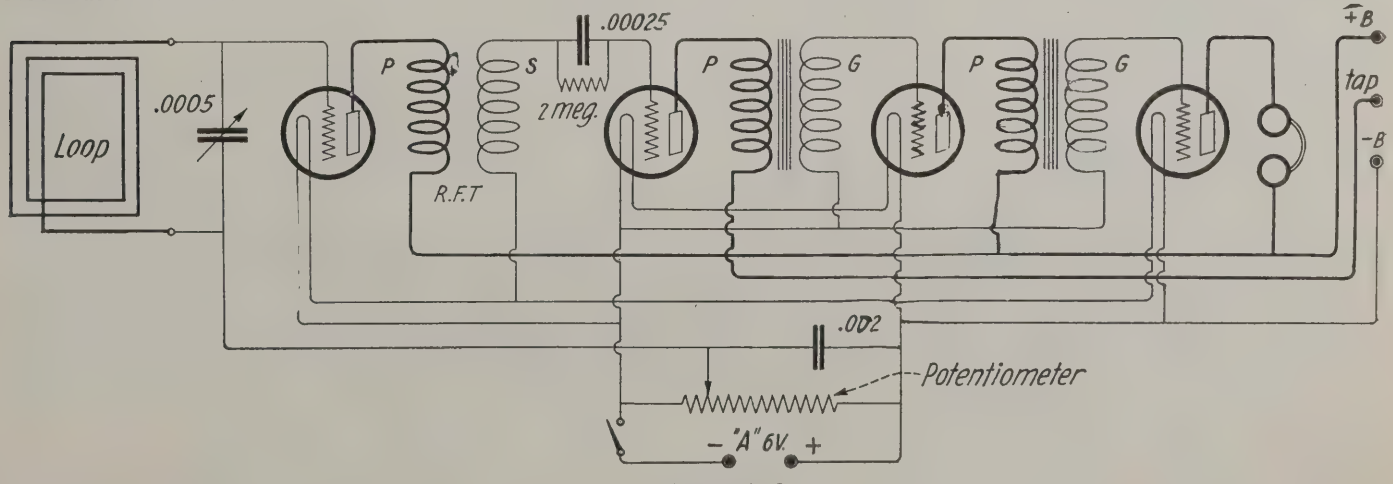
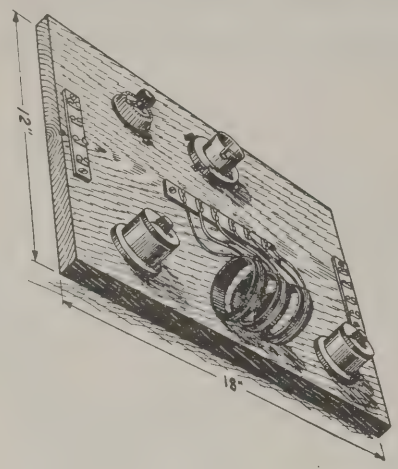


FIGURE 6

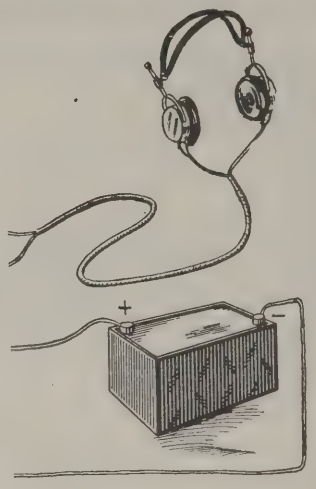
RADIO ENGINEERING



A Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Continued from the February Issue of THE WIRELESS AGE



LAST month in "Radio Engineering" we started something; now starting things is our specialty; it's the the windup—the finish—that cramps us. Happily, however, if we wished we could drop all the readers who intend to follow this series and we are confident that, leaving them to their own devices with only an experimental receiver and Bucher's "Wireless Experimenters' Manual," they would dig in for themselves and learn all those things which we intended to write up. And, learning by themselves, the knowledge would strike home far more effectively than the printed word ever could. So we have an idea—to hit only the high spots in radio, but to hit them hard—to pound at common fallacies and to pound at them hard—to reach down and drag up fundamentals stripped of haze and mystery and complications.

BUT first let us go back to the experimental set of last month. The student should have found that the secondary condenser was the main wavelength control; that the tickler coil was responsible for regeneration and that proper adjustment of both was necessary for maximum signal strength. He should have found the filament rheostat to be not at all critical so that a fixed resistance could be used instead. He should have mentally divided the circuit into four parts:

1—*The antenna circuit* comprising the aerial, the primary coil, the primary variable condenser and the ground.

2—*The grid circuit* comprising the grid, the grid condenser and leak, the grid or secondary coil; the secondary or grid tuning condenser and the return lead to the filament.

3—*The plate circuit* composed of the plate, the tickler or plate coil, the phones, the plate or "B" battery and the filament.

4—*The filament circuit* composed of the filament in the tube, the rheostat and the "A" or filament battery.

The last three are the vacuum tube circuits and when the second and third have been understood in elementary form the student will have taken an immeasurable big step forward.—More about this later.

If Bucher's book is handy—try some of the circuits he shows; do not be limited to those in which it is specifically stated that honeycomb coils may be used; remember that a coil and condenser serve the same purpose as a variometer,—etc. And remember that a coil of wire is a coil of wire whether it be wound as a single layer, or a basket weave, a honeycomb, a Curkoid, a figure 8, a double o, a spider web or any of the hundred and one forms a coil may take.

Try them out, experiment with them and then see if the following statement does not check up with observations:

In general, any regenerative receiver (or any receiver in a class) is just as good as any other regenerative receiver if the design of each is equally good.

That means a whole lot—it means that we shouldn't say, for instance, that a honeycomb regenerative set is better than a variometer regenerative set; that we shouldn't say a double circuit regenerative set is better than a single circuit regenerative set—and so on.

But understand that that statement doesn't prohibit one from saying a certain condenser, or tube or coil or headset is better than some other condenser or tube or coil or headset. In other words, the last eight words provide a solid bridge upon which we can walk back or retreat; the statement is correct.

One realizes then that an efficient receiver depends upon the design of each thing; not upon the trade name of the circuit. So, study the experimental set and note all the little things that go to make perfection. Observe that the grid return should go to the positive side of the filament at least when a grid condenser and leak is used in a detector circuit. (1) Does placing the primary condenser in either the aerial or the ground lead make any difference? (2) Does reversing the primary connections help any? (3) How should the tickler be connected to produce regeneration? (4) Is a variable grid condenser of any value? (5) Is a variable phone condenser of any value?

(1) Very little. (2) No. (3) If both coils are wound in the same direction the plate and grid should be connected to corresponding terminals. (4) Some; hardly worth while though. (5) Same as 4: In either case the condenser provides a fine control of regeneration.

NOTE: Read Bucher's book, especially the part on vacuum tube circuits and vacuum tubes. Also obtain "Radio Communication Pamphlet No. 40"—Bureau of Standards and read it thoroughly, but slowly, and digest each sentence; it will take many months to do this; but if it is done properly——!

In last month's issue we meant to specify D. S. C. wire; the D. C. C. would not fit easily on the 1 inch form. Next month we will try to clear up the problem of inter-tube coupling at both radio and audio frequencies.

(*To be continued.*)

How to Tune Out Local Stations

An Easily Constructed Wave Trap

By C. W. Horn

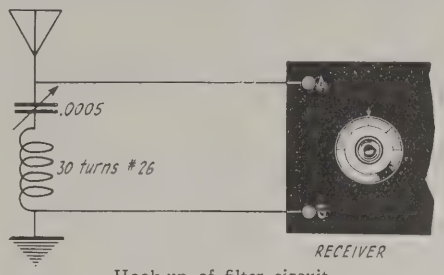
Supt. Radio Operations, Westinghouse Electric & Manufacturing Co.

THOSE of us who have sensitive radio receiving sets know how sharply a distant broadcasting station tunes in. We know from experience how carefully we must adjust our dials to get any particular station. A few divisions off on the scale and it is lost.

When a receiving set is located near a powerful broadcasting station, you are able to hear that nearby station over a considerable range of the dial because of what is known as "forced oscillations."

This can best be described by referring to that analogy so often used of a pond of water after a pebble has been thrown into it. Waves radiate from the center of disturbance. At some little distance from this center the waves are regular and travel smoothly, but right near where the stone struck the water, and particularly if it was a large one, you will notice a large number of irregular splashes.

Any device designed to be affected by the regular waves would also be troubled by these irregular splashes or waves as you may call them. It is the same thing in radio and the problem is to so arrange matters that these irregular splashes can be deflected or



Hook-up of filter circuit

so handled as not to interfere.

In your radio set you desire to pick up the tune or, as before named, the regular wave and weed out the irregular or forced oscillations. This may be done in several ways by devices called traps or filters. I will describe here a very simple one—something you can easily construct for yourself in a few minutes with simple apparatus usually used in radio.

This filter that I am about to describe is so arranged and connected that it tends to offer a very low resistance path to the wave that is not wanted, while the tuner dial is set to offer an easy path for the desired wave which, therefore, passes through your receiver and is registered. Therefore, this circuit must be connected in such a manner that it can be tuned to the undesired wave and also so that the energy so picked up blazes the receiving apparatus.

Take pencil and paper and jot down the figures and diagram I am about to give you.

The circuit consists of an inductance and capacity either of which may be variable. It probably is simpler to use a variable capacity or condenser as it is usually called. This variable condenser may be of the twenty-three-plate type and can be purchased for a nominal sum in any store handling radio equipment if you should not happen to have one.

Next, obtain a small inductance of about twenty-five or thirty turns of small wire, any size in the neighborhood of 24 or 26 B and S gauge, or if you have a so-called honeycomb or spiderweb coil, so much the better.

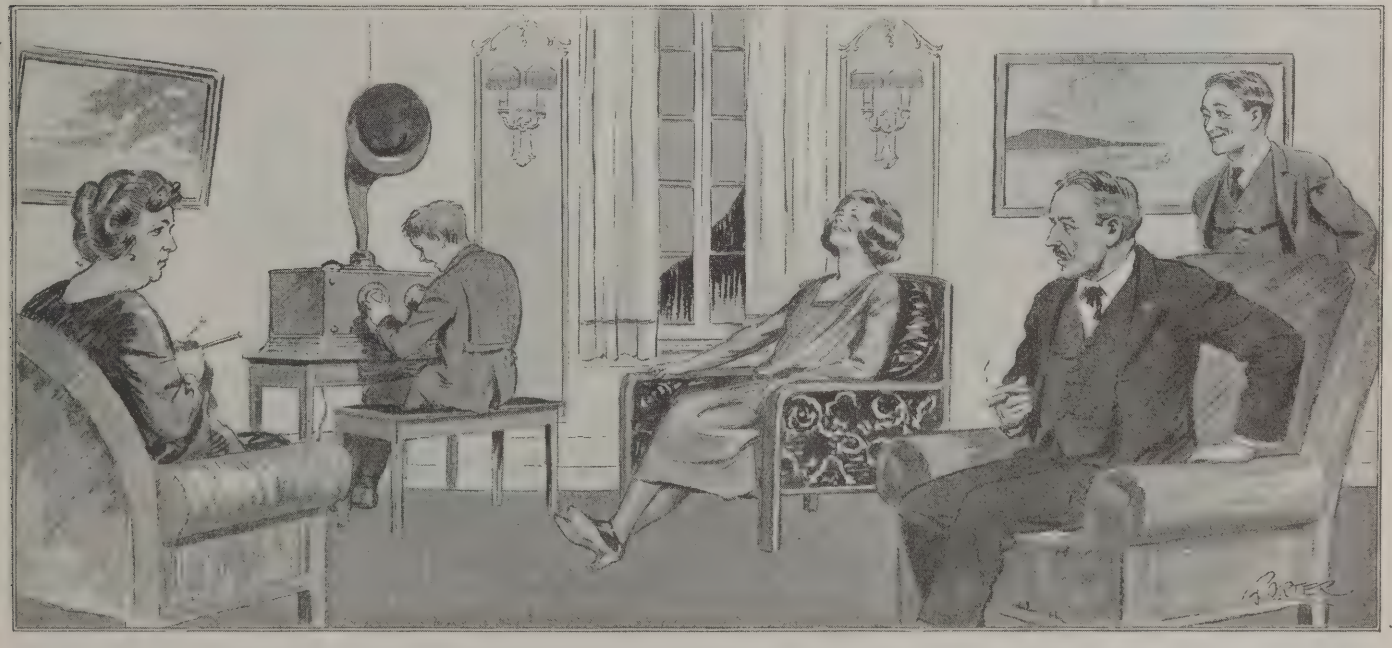
This inductance, however, easily can be made by winding about twenty-five or thirty turns of wire on a cardboard tube two or three inches in diameter. Caution! Do not wind on a metal tube.

Connect this inductance in series with the variable condenser and connect this combination across your receiving set between the antenna binding post and the ground binding post.

This is so that energy from the an-

(Continued on page 62)

Hundreds of Titles Have Been Received—Add Yours



PRIZE CONTEST ANNOUNCEMENT—WHAT IS THE TITLE FOR THIS PICTURE?

For the best title to this picture submitted before March 31, 1924, THE WIRELESS AGE will give as a FIRST PRIZE—A WIRELESS AGE Reflex Receiver (described in February number). The next best title will receive a Second Prize of Five Dollars. The 3d, 4th and 5th prizes which will be awarded in this contest will be subscriptions to THE WIRELESS AGE. THIS IS FOR YOU! What is this picture about? And what is the snappy title that is needed to give the clue? Send in your suggestion to the Contest Editor, THE WIRELESS AGE. Don't delay.

Mount Instruments on Sub-Panel

Metal Shielding is Not Effective in Home-Made Receivers

By Milton Lock

FREQUENT complaints made by owners of shielded receivers that their sets are still affected by hand capacity has prompted the writer to set forth herein the futility of shielding as installed in present day amateur constructed sets.

The usual method of construction is to mount most of the instruments on the panel while the shielding on the panel has holes cut just large enough to clear all current carrying metal. This shielding is then grounded.

In elaborately shielded sets not only the panel but also the base and all sides of the cabinet are shielded.

The writer has installed, and also taken out shielding on several different types of sets, and in each case the shield not only failed to decrease body capacity to any appreciable extent, but it actually reduced signal strength so that DX stations, which before shielding came in easily, were very difficult to pick up.

That there is a possibility of capacity effect between the instruments on the panel and the grounded shield a series of tests conducted by the writer has satisfactorily demonstrated.

The shield coming close to condensers and inductances act with each as a miniature condenser, coupling them with the ground.

The shield acts as one plate while the nearest metal part of the instruments serve as the other conducting surface and the air or paneling act as the dielectric.

In one test where a rotary plate condenser was mounted parallel to the panel a capacity as high as 46.21 micro-microfarads was found to exist between it and the shield.

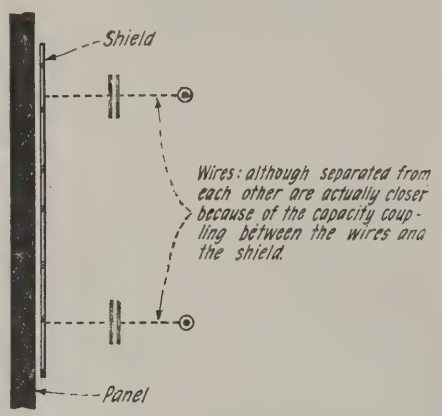
Wire leads were found to be subject to the same capacity effect if run close to the panel. Moreover further complications arise here for any two wires even if at right angles to one another, but both parallel to the panel, will have a capacity effect between them which will be approximately equal to the capacity of the same two wires running parallel and spaced the same distance apart as the sum of the spacing of both from the shield.

In summing up the foregoing it follows that not only does the shield capacitively couple all instruments to the ground, but it also serves to couple them to one another.

In the course of the above tests it was also found that in cases where poor insulating material was used in panel or instruments there was a direct—but of course high resistance—short to the shielding. The ordinary battery and light, or even phones would not show this, but with delicate instruments connected across resistances as low as 14 megohms were found in some sets.

Such relatively low resistance shorts may seem negligible to the average reader, but for those who want the acme of efficiency to go after DX records these details must be taken into consideration.

The reason this type of shielding does not effectively prevent body capacity is really due to this capacitive


Shield
Wires: although separated from each other are actually closer because of the capacity coupling between the wires and the shield.
Panel

Showing capacity coupling of wires because of shield

coupling between shield and instruments.

The hand being brought near the set is coupled to the shielding both by the ground and the capacity of hand to shield hence the effective surface of the shield is augmented by the surface of the hand or body, thereby increasing the capacity betwen shield and instruments. Any change in the capacitive coupling of hand to shield will cause a change in the capacity to the instruments.

From the above discourse on shielding the reader may be led to believe that by discarding it from his set greater distance and volume might be obtained. This is exactly the opinion that it is wished to convey.

The writer does not want to say that there are no sets which shielding will help, but in none of the various sets which have come under his notice, has the shielding effectively performed its purpose. The only real method of doing away with body capacity is to mount the instruments on a sub-panel at least three inches from the main panel and then bring the control knobs and dials out by means of shafts made of insulating material.

[Note:—Mr. Lock's statements are applicable only to amateur constructed receivers: Commercial sets with shielding of proper engineering design have proved immune to detuning effects due to external body capacity variation. The RC set is a splendid example. For effective shielding, in addition to spacing the instruments from the metallic shields so they will be in a weak portion of the electrostatic and electromagnetic fields it is advisable to have all the live shafts connected in the circuit in such a way to keep them at ground potential. Likewise, the metal shields should have sufficient thickness to be of benefit. Where the front panel only is to be shielded and the instruments cannot be spaced back from it, separate shields for each part rather than a single large shield for the entire panel should be provided. If carefully carried out this will reduce hysteresis losses to an appreciable extent.—Technical Editor.]

How to Tune Out Local Stations

(Continued from page 61)

tenna also can flow through the filter circuit, or as we have described "inductance and capacity in series," through to the ground—as well as enter the receiving set. Make sure that there is no coupling between these two circuits and in order to prevent this keep the filter circuit several feet away from the receiving apparatus.

After having done all this, we are now ready to try it out. Wait until a local station begins operating and then try and tune in another station. That means you have set your dial at the point where the desired station can be heard, but it is being interfered with by the local station.

Now adjust the variable condenser of the filter circuit until the interference has been reduced to a minimum, at the same time readjusting your receiving set so that the desired station comes in as strong as it is possible to make same. A little practice will soon enable you to obtain sharp tuning.

This filter circuit is not a hundred per cent. perfect, but it is believed that for the amount of money invested and the simplicity of this arrangement, the results are worth while.

This device depends upon low losses in the filter, particularly in the condenser. Great care should be taken to make sure the variable condenser used is a "low loss" condenser.

This device will drain unwanted frequencies off the antenna, but it will not weed out unwanted frequencies from the receiving circuit itself.

Eveready gives you the right battery *for every radio use!*

EACH Eveready Radio Battery represents thirty years of battery building experience. Each Eveready Battery represents millions of dollars invested in men, methods and machinery. Overseeing Eveready production is the greatest battery laboratory known to science, where every particle of raw material is required to pass Eveready's exacting tests. To insure Eveready serviceability, batches of Eveready Batteries are constantly being set aside for performance tests. And, finally, daily shipments keep dealers supplied with fresh Eveready Batteries, packed full of power.

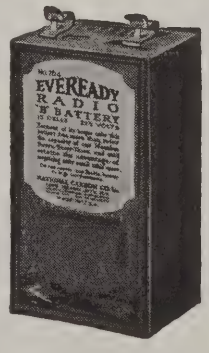
To be certain of battery satisfaction, insist on Eveready Radio Batteries—they last longer.

EVEREADY Radio Batteries

—they last longer

The radio dry cell triumphant

For economical, satisfactory radio, light the filaments of your dry cell tubes with the Eveready Dry Cell Radio "A" Battery. Will unfailingly outlast any other at ⅛ ampere current. Full instructions for getting this Economical Eighth, on labels and in our booklets. This battery will exceed your expectations in economy and performance.



Equal to all demands

Power flows from your "B" Battery, power that gives life to your head-phones or loud speaker. Some tubes draw more "B" Battery current than others, but whatever the tube or tubes you use, Eveready "B" Batteries will give you maximum results. Eveready "B" Batteries are made in six sizes, for all possible uses. Always use the biggest possible battery, for it contains more energy in proportion to cost, and lasts longer.

This battery is a wonder worker

Eveready's biggest contribution to economical and more satisfying radio is the Eveready "C" Battery, a triple-use, universal battery. It will make the loud speaker respond with a new fullness and naturalness of tone, and save much money by making the "B" Battery last still longer. Connect it with the grids of audio frequency amplifiers and notice the big difference. Can also be used as an "A" Battery for 199-type tubes in portable sets, and as a "B" Battery booster. Eveready Radio Battery No. 771—use it!

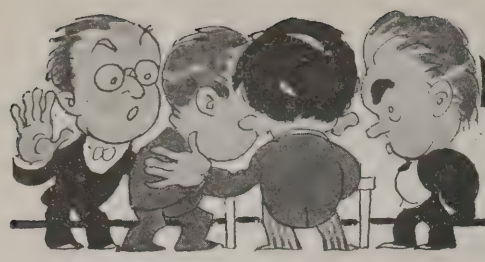
NATIONAL CARBON COMPANY, INC., New York and San Francisco

Headquarters for Radio Battery Information

CANADIAN NATIONAL CARBON CO., Limited. *Factory and Offices:* Toronto, Ontario

Informative and money-saving booklets on radio batteries sent free on request. If you have any radio battery problems, write to G. C. Furness, Manager, Radio Division, National Carbon Co., Inc., 198 Orton Street, Long Island City, N. Y.

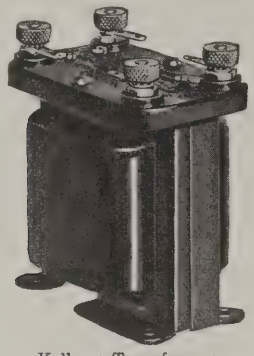
"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



NEW APPLIANCES AND DEVICES

Kellogg Transformer

THE engineers of the Kellogg Switchboard & Supply Company were given the problem of producing an audio-frequency transformer that would function as well in the amplification of low frequencies as high frequencies. After a great deal of research work and numerous practical tests, they designed a really splendid transformer.

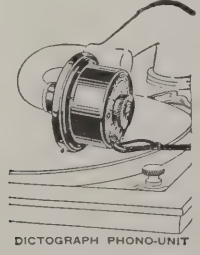


Kellogg Transformer

This audio frequency transformer embodies many excellent features: First, the iron core is of proper size and construction to operate properly on low voice frequencies and it has no holes for mounting or other purposes, so eddy current losses are reduced. Secondly, the windings have the correct impedance to work properly with modern vacuum tubes over a wide range of frequencies. The insulation between separate wires and between the coils is of high quality so that breakdowns are unknown. Lastly the transformer is encased in a special enameled brass case and the terminals are brought out to plainly marked binding posts so that the user is assured of maximum results with his amplifier.

Dictograph Phono-Unit

THE Dictograph Products Corporation is now marketing the Dictograph Phono-Unit, a phonograph attachment that is



DICTOGRAPH PHONO-UNIT

adaptable to all makes of phonographs and requires no extra batteries.

A calibrated dial on the back of the Phono-Unit permits the user to determine accurately and select a quality of reproduction equal to that secured with a loud, medium, or soft needle on the phonograph.

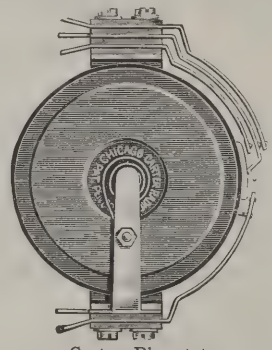
A handsome, heavy nickel plate finish insures the Phono-Unit harmonizing with the richest of phonograph cabinets.

Cutting & Washington Radio Corp. Adopt New Rheostat

THE Cutting & Washington Radio Corp. has adopted the new Carter Automatic Control Rheostat which is practically a combination of rheostat and jack. The method at present is to use a filament control jack to plug-in for detector, first, second and third stages. With such an arrangement a rheostat has to be used and there are the two operations of plugging-in and then regulating the filament by the rheostat.

When the Carter Automatic Control Rheostat is used in a circuit you plug-in your head phones or loud speakers, which remain in the same position whether you use the detector or one or several stages of amplification.

Immediately when you turn the rheostat the plate circuit is automatically cut in without the necessary plugging in of your head phones. All you have to do is to adjust your filament.



Carter Rheostat

The Automatic Rheostat is a fundamentally new method of amplifier control. It gives vernier control without additional knob or parts. The contact is stationary. The resistance wire is wound in a small spiral. This spiral rests in a groove around the outer edge of a disc and revolves past the stationary contact.

This Automatic Control Rheostat does away with a lot of extra parts, is simpler to wire into a circuit and provides the simplest method of inter-stage control. It is made in three resistances—6, 20 and 30 ohms—and can be used with all tubes.

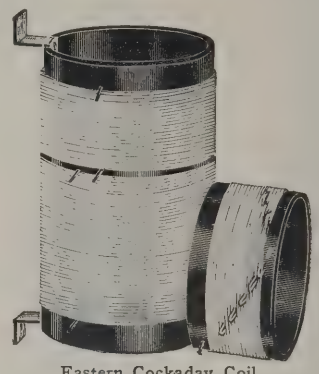
Tungar Charger for Two and Four-Volt Batteries

THE General Electric Company has developed an adapter to the standard Tungar Battery Charger so that it may be used to charge not only the regular six-volt storage battery, but also the two and four-volt ones used in conjunction with dry-cell tubes such as the WD-11 and the WD-12 and the UV-199.

This adapter fits inside the Tungar case and can be attached in a few moments. It should meet an enthusiastic welcome from the fans who use small storage batteries.

Eastern Coil Sets for Cockaday Circuit

A NEW and improved coil for use in the famous Cockaday circuit is being placed on the market by the Eastern Radio Mfg. Co., New York. This coil has several distinctive features and is built exactly in accordance with Mr. Cockaday's specifications.



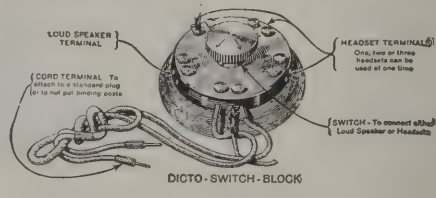
Eastern Cockaday Coil

A circular describing this four-circuit tuner may be secured upon request from the Eastern Radio Mfg. Co., 22 Warren Street, New York.

Dicto-Switch-Block

IN one compact unit, the Dictograph Products Corporation's Dicto-Switch-Block provides a means for throwing into circuit a loud speaker, or one to three pairs of headphones—simply by a short turn of a knob switch. No matter how often the switch is thrown, the most delicate adjustment of the receiving set is left undisturbed.

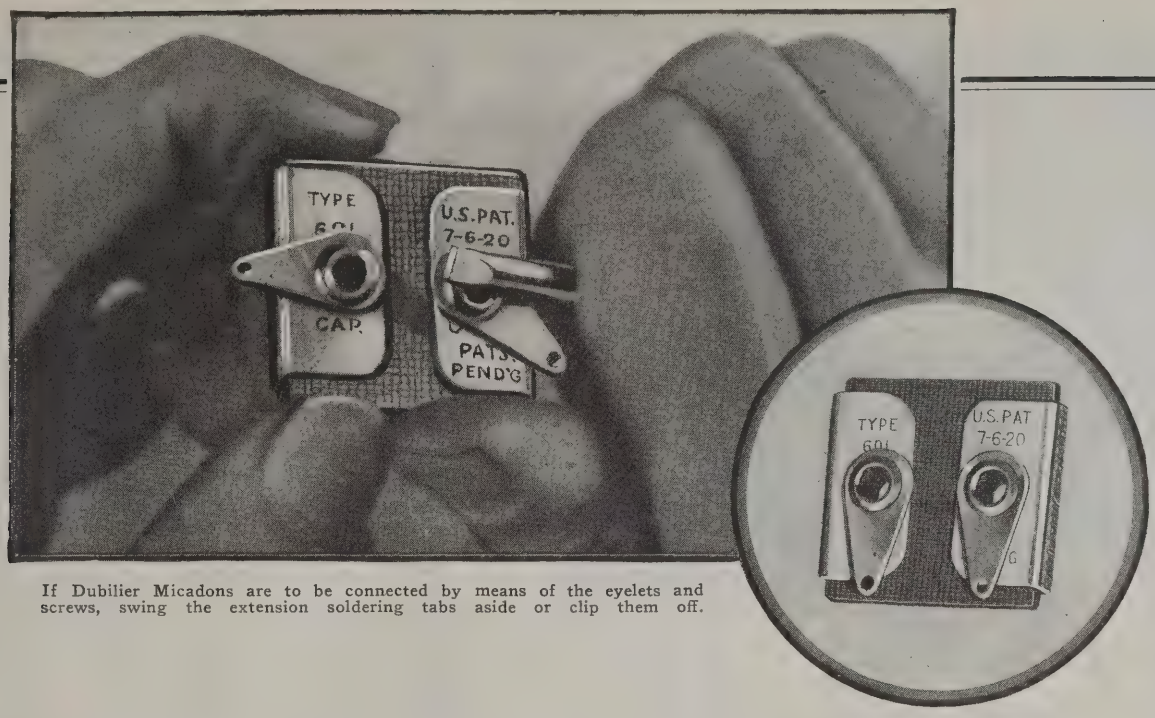
The Dicto-Switch-Block is provided with a regular phone cord which may be permanently attached to the output terminals of the receiving set, or inserted in any standard plug. This arrangement permits delicate tuning with the headphones after which the headphones may be cut out and the loud speaker brought in, all with one quick twist of the switch.


LOUD SPEAKER TERMINAL
CORD TERMINAL To attach to a standard plug (or to nut put binding posts
HEADSET TERMINALS One, two or three headsets can be used at one time
SWITCH - To connect either Loud Speaker or Headsets

DICTO-SWITCH-BLOCK

With the Dicto-Switch-Block permanently connected and attached to one, two or three headsets, and to a loud speaker, all bothersome attaching and detaching of receiving units is done away with, thus facilitating operation for those unfamiliar with radio sets.

Finished in mahogany and capped with genuine hard rubber, the Dicto-Switch-Block will match any standard set.



If Dubilier Micadons are to be connected by means of the eyelets and screws, swing the extension soldering tabs aside or clip them off.

Dubilier Micadons for any Circuit

Dubilier Micadon, type 601, is now made with extension soldering tabs. These facilitate mounting. The hot soldering iron need not touch the Micadon directly. Hence the capacity cannot be affected by the heat.

If Dubilier Micadons are to be mounted with screws simply push the soldering tabs aside or clip them and use the eyelets.

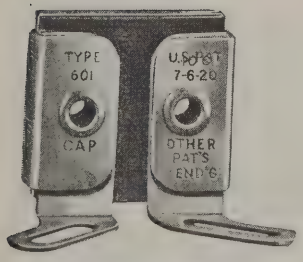
Thus the Dubilier Micadon, the standard of radio because of its permanent capacity, becomes even more convenient.

Dubilier Micadons are retailed at 35 cents up, depending on style and capacity.

There is a Dubilier Micadon for every circuit requirement. If your dealer cannot supply Micadons write to us.

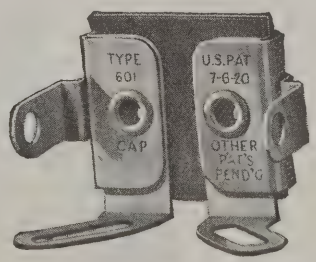
Dubilier Condenser and Radio Corporation

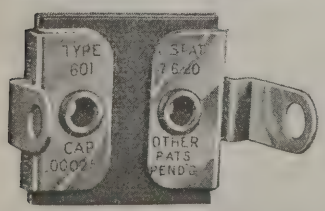
40-44 West Fourth Street New York



Micadon type 601 T has adjustable clips which slip over transformer and other binding posts.

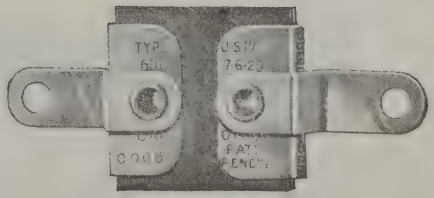
Micadon type 601 G-T has clips to hold a fixed grid-leak and adjustable clips that slip over binding posts.

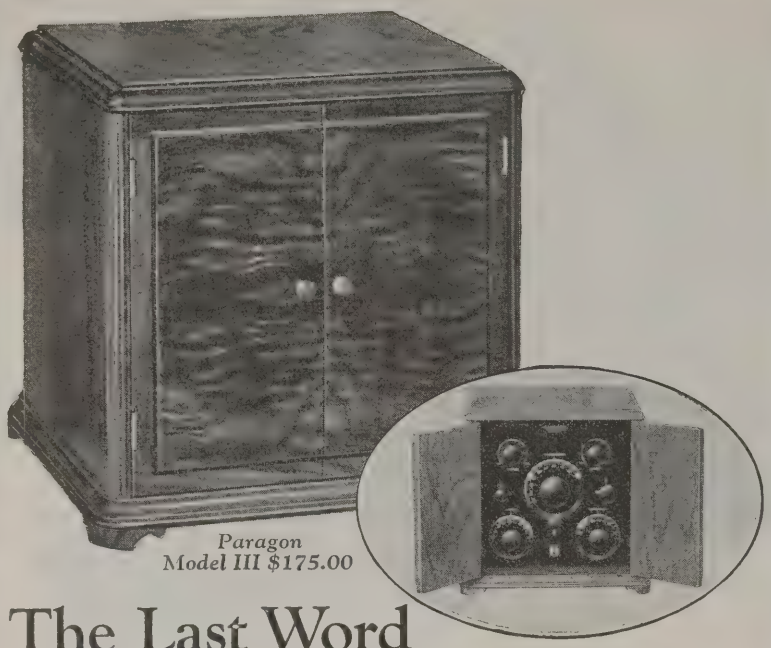




Micadon type 601 G has clips to hold fixed grid leaks (Grid leaks not supplied with Micadons).

Micadon type 601 L has eyeletted tabs that slip over the terminals of a variable grid leak.





Paragon
Model III $175.00

The Last Word In a Paragon Receiver For the Home

At last—a radio set that not only harmonizes with your furniture but adds to the attractiveness of any room in which it is placed. And not an ordinary radio set but a PARAGON.

Paragon Receivers are famous for the long distance records they hold, which include the reception of the first trans-continental amateur message and the first trans-Atlantic message. It is a Paragon that keeps the world in touch with the MacMillan Expedition, frozen in north of Greenland.

Paragon Receivers, because of their superior selectivity and sensitivity, are equally famous for the ease with which they can be operated and the clear results obtainable.

The Model III, pictured above, has all the advantages of the other models but is housed in a mahogany or burled walnut cabinet which is a work of art.

In appearance, the Paragon Model III Receiver now matches up in every way to the perfection of the instrument itself.

Write for illustrated catalog of Paragon Radio Parts

Dealers: We believe in the proper distribution of Paragon Radio Products. Our Exclusive Distributors are particularly interested in territorially protected dealers, who will concentrate, solicit and serve the consumer in the sale of Paragon Radio Receivers. If interested, write us for details.

ADAMS-MORGAN CO., 8 Alvin Avenue, Upper Montclair, N.J.

PARAGON

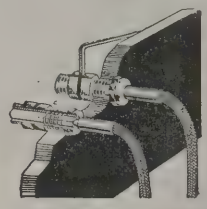
Reg. U. S. Pat. Off.

3-CIRCUIT RECEIVER

Na-ald Phone Tip Jacks

NA-ALD Phone Tip Jacks make a very easy and a very satisfactory means of connecting as many sets of phones and loud speakers as are desired, either in series or in parallel. To install these jacks all that is necessary is to bore ¼-inch holes in the panel, clamping the bus wire under the nut and lock nut provided. Extra sets can be connected either in series or parallel.

The Na-ald Jack grips all sizes of terminals, making positive contact and holding them firmly. At the same time the tension



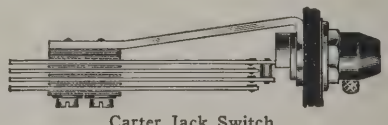
Na-ald Phone Jacks

is such that they can be easily removed and changed from one stage of amplification to another. They have an advantage over the ordinary jack in the various combinations of connection possible as well as cost and ease of installation. It is not necessary to solder the bus wire connection.

New Carter Jack Switch

A COMPACT and durable radio switch to open and close circuits has been devised by the Carter Radio Company.

The principle is the same as used in a jack, though unlike push and pull switches, there are no snaps to wear out or work loose and make poor contacts. A quarter turn of the knob operates the heavy low-resistance, phosphor-bronze contact springs, connecting or disconnecting the silver contacts. The insulation is Westinghouse Micarta 1/16-inch thick between the springs. This material will not contract, expand or absorb moisture. The frame is heavily nickel-plated and highly polished on all sides. The switch is easily mounted on the panel, like a jack. One adjustable lock-nut holds the switch securely in place. An "On and Off" name plate mounts on the



Carter Jack Switch

front of the panel and is furnished with the switch; also a knob and pointer. This switch will safely carry 10 amperes.

The switch is made in the following four styles: Two springs—closes one contact. Can be used to close the "A" battery. Three springs—opens one and closes one contact. Can be used for switching from long to short wave, and from one dry "A" battery to another. Four springs—closes two contacts. Can be used in second head set; also for adding a second cell in parallel; also for closing the "A" and "B" battery circuit. Six springs—opens two and closes two contacts. Can be used as a series parallel switch or to switch battery charger or loud speaker on and off, etc.

The Carter Radio Company have prepared diagrams showing some of the uses for this switch and will be glad to mail copies to those readers who are interested.

AMPLION

The World's Standard Loud Speaker

You Never Tire of the Amplion

THE most striking thing about the Amplion is that its reproduction is never tiring. Its perfect rendition, absence of harshness gives you a thrill that is pleasing and refreshing.

No matter if it's voice or instrument, the charm is there. The message has lost nothing in its flight through space. It holds you and enthrals you just as if you you were listening to the original.

The Amplion is made in several sizes to suit all occasions and pocket books from $18.00 for the Junior model to $66.00 for the Concert type.

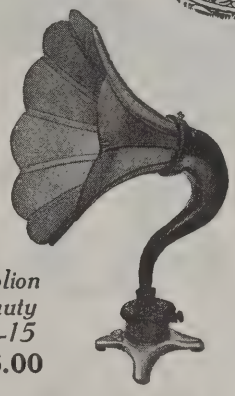
Ask your dealers to let you hear the Amplion. You owe it to yourself to hear the world's standard loud speaker before you buy.

Folder of styles and prices on request.

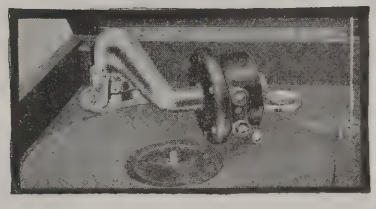
Patentees:
Alfred Graham & Company

Signal Electric Mfg. Co.
Sole U. S. Distributors Menominee, Mich.

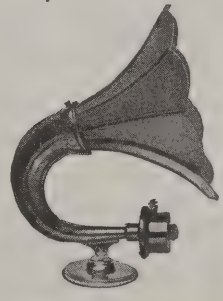
BURNDEPT OF CANADA, Ltd.
Canadian Distributors
172 KING STREET, W., TORONTO



Amplion Beauty AR-15 **$46.00**

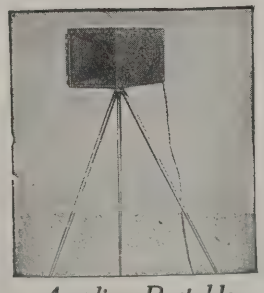


Phonograph Unit AR-35—**$24.00**



Amplion Dragon AR-19 **$40.00**

Amplion Junior De Luxe AR-43 **$26.00**



Amplion Portable AR-61—**$50.00**

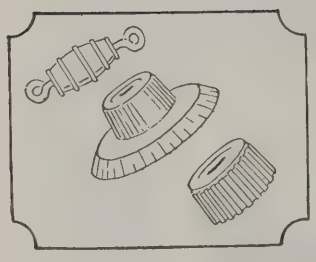
Amplion Junior AR-39 **$18.00**

The Supremacy of the AMPLION is the Supremacy of Actual Performance

RADION

The Supreme Insulation

PANELS



They Do Not Chip When Drilled

Drill, saw or engrave a Radion Panel. Use what tools you will, dull or sharp, this material will not chip or show ragged edges. Its proven electrical values make RADION the supreme insulation both from a scientific and a practical standpoint.

Made in the beautiful MAHOGANITE or polished black with Dials and Knobs to match.

Look for this stamp on every genuine Radion Panel. Beware of substitution and imitation.

At all good dealers or write to

AMERICAN HARD RUBBER COMPANY

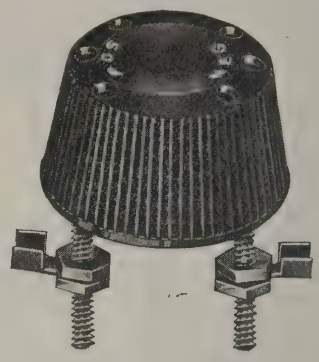
11 Mercer Street NEW YORK

Eby Tip Top Post

THE H. H. Eby Company have put on the market a unique development in binding posts.

The Tip Top Post is designed to take the place of the conventional phone binding posts, and is constructed to take three pairs of phones or two pairs of phones and a loud speaker.

The terminals are marked so that proper connections are assured.



Eby Tip Top Post

Cutting & Washington Receiver

A NEW entirely self-contained 3-tube and double circuit regenerative receiver, designed for long range and selectivity, is announced by the Cutting & Washington Radio Corp., of Minneapolis, Minn.

The receiver was designed by Dr. Fulton Cutting and Bowden Washington, designers of U. S. Naval and Allied radio apparatus during the war, and was built under their direction.

It uses three UV-199 tubes, three large A batteries, B batteries, shock absorbing tube mounts to prevent vibration howls, shielded panel and automatic rheostat switches with all wires back connected. The receiver is known as the Model 11-B.

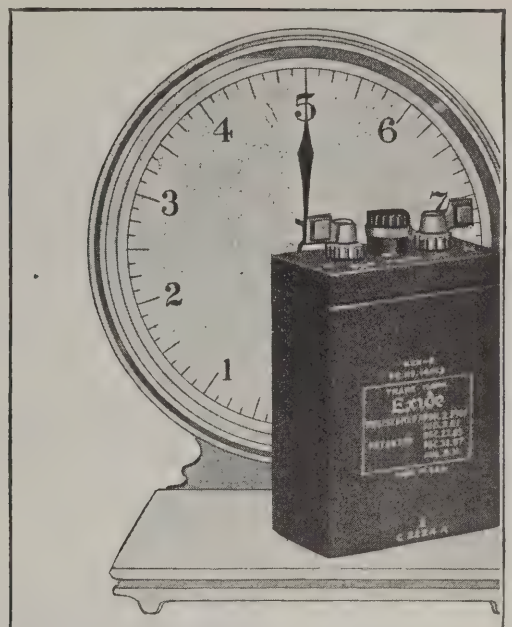
Alexanderson High Frequency Alternator in Europe

E. F. W. ALEXANDERSON, consulting engineer of the General Electric Company and chief consulting engineer of the Radio Corporation of America, has been awarded the Order of the Polonia Restituta by the Polish Government, in recognition of his meritorious services in connection with the building of Poland's new radio station near Warsaw.

The Polish station is the first in Europe to make use of the Alexanderson high frequency alternator now used in all Radio Corporation stations for trans-oceanic communications. During the two months the Polish station has been in operation it has gained the reputation of being the most efficient transmitting station in Europe.

A similar station, being built in Sweden, is expected to be ready for operation by mid-summer. These two new stations will not only serve their own countries with an adequate and quick means of communication with America, but will tend to more closely link Eastern Europe with this country.

To get best results with low-voltage tubes

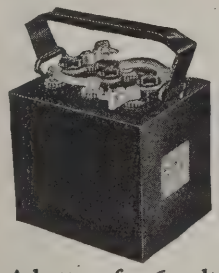


This 2-volt A Exide storage battery weighs only 5 pounds

FOR perfect clearness you must use a storage battery with uniform current. This is particularly true if you are a fan for long distance. When signals are weak, the steadiness of a dependable A storage battery is indispensable to good receiving.

There are two tiny but sturdy Exide A Batteries designed specially for WD-11 and UV-199 vacuum tubes, and they give fine service with any low-voltage tubes.

You can carry one of these little batteries in the palm of your hand, yet they are powerful enough for long-distance receiving and have the true Exide ruggedness built into them.


A battery for 6-volt tubes

Three sizes of A batteries

The 2-volt battery has a single cell and weighs five pounds. It will heat the filament of a WD-11 or other quarter-ampere tube for approximately 96 hours. The 4-volt battery has two cells, weighs six pounds, and will light the filament of a UV-199 tube for 200 hours.

The Exide A Battery for 6-volt tubes is made in four sizes—of 25, 50, 100, and 150 ampere-hour capacities. These batteries have extra-heavy plates, assuring constant voltage and uniform current over a long period of discharge.

A battery with a pedigree

A good storage battery does not just happen. It is the result of long experience. The skill acquired and the resources developed in making batteries for every purpose since the beginning of the storage battery industry thirty-five years ago are built into the Exide Batteries made specially for your radio.

Wherever batteries *must* be reliable—such as on submarines, in the telephone system, in firing the guns of our battleships, in the central power stations of our great cities—there you will find Exides doing their unfailing duty. While the weight of the smallest Exide radio battery is only five pounds, the great Exides used in central power stations sometimes have as many as 150 cells, each cell weighing three tons—or nearly a million pounds for one battery.

A majority of all government and commercial radio plants are equipped with Exide Batteries.

Exide Radio Batteries are sold by radio dealers and Exide Service Stations everywhere.

Ask the dealer, or write direct to us, for booklets describing the complete line of Exide Radio Batteries.

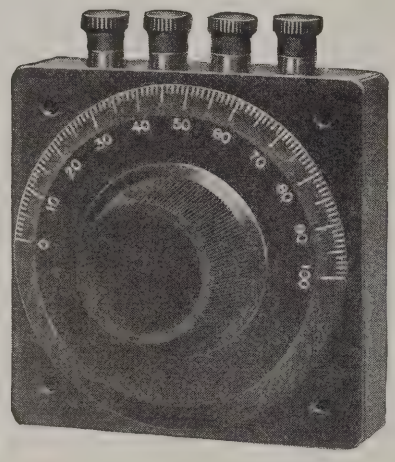
Exide
RADIO BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

Manufactured in Canada by Exide Batteries of Canada, Limited, 133-157 Dufferin Street, Toronto

Pathé
REG. U.S. PAT. OFF.

PHUSIFORMER
Type "P"



Price
$8.50

This latest development in the radio field meets the following requirements necessary in building an ideal receiver:

Non-oscillation.
Non-reradiation and non-interference.
Sensitive to distant stations.
Freedom from hand capacity.
Synchronized and calibrated tuning.
Simple operation and construction.
Highly selective.
Inexpensive.
Wave Trap.

(Phusiformer is derived from the Greek word Phusikos, meaning "Natural.")

Jobbers and dealers—Watch for national and local advertising and publicity on Phusiformer type "P." Several territories still open for live jobbers and dealers.

PATHÉ PHONOGRAPH & RADIO CORP.,
20 GRAND AVENUE, BROOKLYN, NEW YORK
WESTERN SALES OFFICE: 533 South Wabash Ave., Chicago, Ill.

Industrial Inklings

MANY manufacturers in the radio field are making rapid progress in the development of their merchandising efforts.

In the majority of cases, the progress is being made by the manufacturers of sets, phones, loud speakers, etc., whose product is

sufficiently bulky to permit of an impressive display.

Manufacturers of small parts are handicapped in displaying their products because of size, and ingenuity has to be exercised to impress the buying public as to the merits of goods that may be lost sight of in the proverbial commercial haystack.

The latest Eby stunt is the container pictured above, which combines the two virtues of displaying a small product and creating sales through the suggestion of a complete set of marked parts to the man who is buying the material for a set. This is real selling.

THE Belden Manufacturing Company has combined a circular letter and catalogue with a four-page fly, that ought to be an inspiration to other manufacturers of very small parts and accessories. The outstanding feature of this circular is a talk to the trade on "How to increase their counter profit."

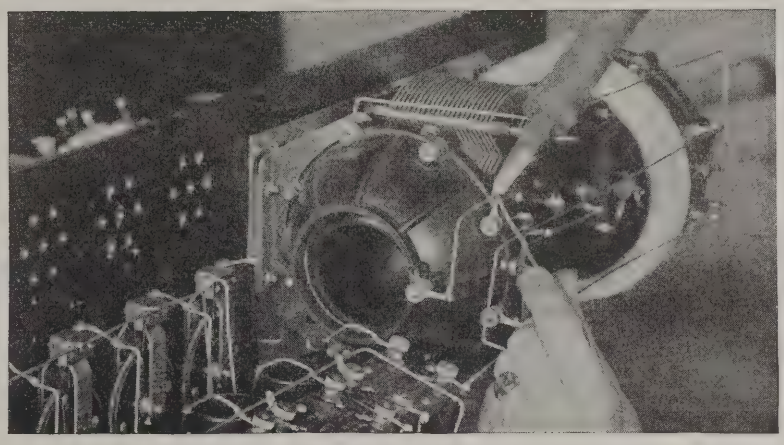
FRANK T. CHASE has joined the Zinke Company, as vice president in charge of merchandise.

AS announced in "Continental News" and through printed announcement to the trade, and extensive advertising in the trade and national magazines, Continental Radio and Electrical Corporation have closed their retail store at 6 Warren Street and are devoting their entire energy to the expansion and building-up of their wholesale business. The present main office at 15 Warren Street is being enlarged and a carefully laid out show-room is being added.

WASHINGTON'S first radio show will be held in Convention Hall from March 19th to 26th. The show will be staged under the auspices of the Radio Merchants Association of Washington. Many of the popular features of the Chicago, New York, Philadelphia and Boston shows will be incorporated in the Washing-

KELLOGG RADIO PARTS

Easy { to Mount / to Wire / to Solder / to Tune



No Fussing or Re-drilling, Just Mount and Solder

They furnish every convenience for quick efficient assembly. And when connected—"O Boy!"

Did you ever hear such volume and still so clear and distinct!

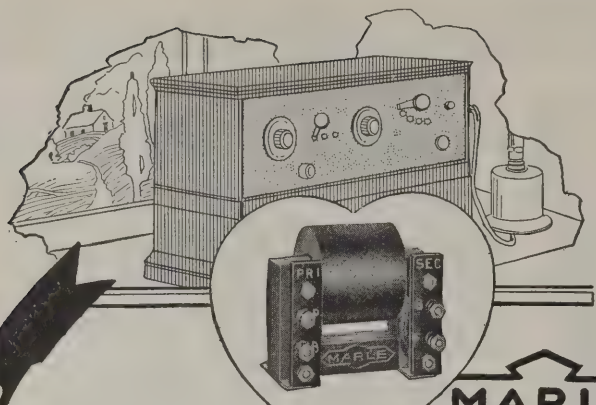
That is the satisfaction of using Kellogg radio equipment—it puts the 'Ray' in Radio.

Join the group of "Happy Radio Fans." They are strong believers in quality, and Kellogg apparatus.

USE—Is the Test

KELLOGG SWITCHBOARD & SUPPLY COMPANY

1066 West Adams Street, CHICAGO

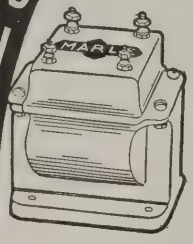


DISTANCE

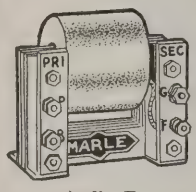
MARLE

Radio & Audio Frequency
TRANSFORMERS

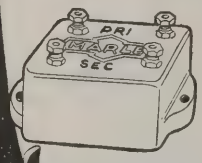
"The Heart of a Good Receiver"



Audio F.
Type A7
Ratio of 3¾ to 1



Audio F.
Type A6
Ratio 5 to 1



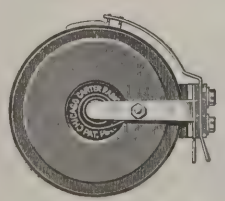
Radio F.
Types R1 and R2

PERFECT *amplification* is the boon you secure when you buy a *Marle Transformer*. Radio impulses are magnified to the uttermost limit without a sign of distortion. True over the widest range of frequencies. Special folders, showing the hookups for standard circuits, sent upon request.

Write for hookups and Illustrated Folder TODAY!

Your Dealer Sells Marle Transformers, or write to us for the names of the nearest Marle dealer.

MARLE ENGINEERING CO.
Orange New Jersey



6 ohms..... $1.50
20 or 30 ohms 1.75

Write for catalog

CARTER
VERNIER CONTROL RHEOSTAT

Carter Vernier Control Rheostat gives that close adjustment so essential to successful broadcast reception, where stations operate on wave lengths but a few meters apart.

A Carter Vernier Control Rheostat will make your set much more selective.

Carter Radio Co.
1802 REPUBLIC BUILDING
CHICAGO

ton program. but they will be supplemented by unique "stunts" arranged by members of Congress and Government officials.

One exhibit of marked historic value will be the $25,000 exhibit of the Radio Corporation of America. Virtually all the important working committees for the show have been organized. Fred S. Lincoln, a prominent Washington business man is chairman of the general show committee. Alfred L. Stern is the director. Officers of the Washington Radio Dealers Association who are responsible for the show are William P. Boyer, president, Fred Huber, vice-president, and W. H. Schultz, secretary-treasurer.

THE Strand Radio-Kraft Corporation has recently opened an exclusive studio at 635 Fulton Street, Brooklyn. Practically every well-known radio set is demonstrated daily, and their plan of selling radio on easy payments will no doubt please the populace of that Borough.

THE Adams-Morgan Company, Upper Montclair, New Jersey, has a new Paragon booklet which presents their small parts in a comprehensive fashion.

THE Howard Radio Company, Inc., Chicago, has put out a booklet that describes the Howard rheostat, potentiometer, multi-terminal receiver plug, and other radio essentials, in a way that enhances their importance.

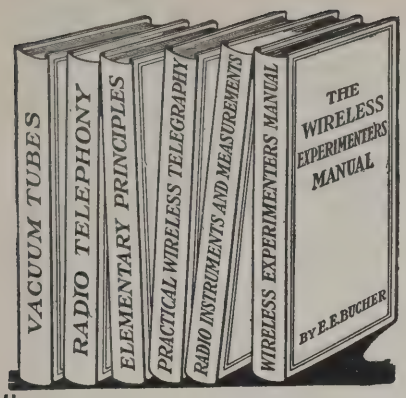
THE Goldschmidt Corporation, 15 William Street, New York City, who are sole importers for United States and Canada of the N & K imported phones, appointed Mr. Harry E. Sherwin marketing manager of their organization.

Mr. Sherwin was for many years associated with Robert Ingersoll & Brothers, both in this country and abroad in the merchandising of Ingersoll Watches. He was sales manager of the A. C. Gilbert Company of New Haven for many years and was particularly responsible for the distribution secured for the Polar Cub Electric Fan and other Polar Cub electrical specialty products. He recently completed a contract for introducing the Bobolink Phonograph Books for children, on which a national distribution was secured in less than six months time.

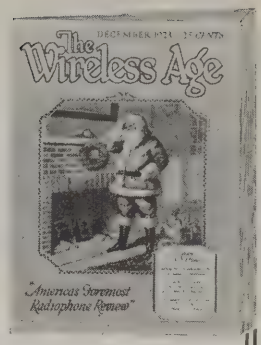
CONVERSATION between Japan and WOR, Newark, New Jersey, was heard on a Dictogrand Loud Speaker in the laboratories of Howard Radio Company. A statement of this remarkable feat was issued by Thomas L. Kennon, manager of the Howard Radio Company and an affidavit was signed by a notary public.

THE Federal Telephone and Telegraph Company at Buffalo, New York, issues a monthly bulletin worthy of comment.

OTHER catalogue-booklets of unquestionable value to radio fans, are those published by the Newark Sunday Call, Newark, New Jersey, Progress Press, Union, South Carolina, and the Charleston Electrical Supply Co., Charleston, West Virginia.



Big Savings
on
Laboratory Tested Radio Books



Pick out the books you want and Buy at these Rock Bottom Prices

Here is the greatest list of radio books ever presented. In this list are books that are known and used the world over.

Our stock room is overcrowded—we must reduce the weight per square foot. This gives you the chance to buy these books at a tremendous saving. Take advantage of this opportunity to complete your radio library.

BOOK	AUTHOR	Regular Price	Class No.
Practical Wireless Telegraphy	E. E. Bucher	$2.25	35
Vacuum Tubes	E. E. Bucher	2.25	35
Wireless Experimenter's Manual	E. E. Bucher	2.25	35
How to Pass U. S. Government Wireless Exams.	E. E. Bucher	.75	10
How to Conduct a Radio Club	E. E. Bucher	.75	10
Alexanderson System	E. E. Bucher	1.25	18
Radio Telephony	A. N. Goldsmith	2.50	37
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Write for illustrated folder of Howard B. Jones Radio Products

Howard B. Jones, 612 S. Canal St., Chicago, Ill.

THE name of the Precision Equipment Company has been changed to the Crosley Radio Corporation. An arrangement has been made whereby the business of the Crosley Manufacturing Company in its entirety has been taken over by the Crosley Radio Corporation. Many economies will be effected in production, administration management, effective as heretofore, with the same personnel in charge.

The Crosley Radio Corporation now occupies three large plants in the city of Cincinnati including its own woodworking cabinet plant. A fourth plant, larger than the present three combined, has just been purchased for additional expansion.

Information Desk

By John R. Meagher

A self-addressed envelope will assure a prompt reply to any queries on radio.

Combining the Super With the Super

M. V. inquires: "Would it be possible to combine both the super-regenerative and the super-heterodyne receivers into one?"

Yes, indeed; we could make use of the short wave amplifying powers of the super-regenerative receiver by heterodyning our incoming energy and producing a beat note of 50 meters or less and passing this along to a suitably adjusted super-regenerative set. Here we would be using the super-heterodyne idea reversed in order to take advantage of the ability of the super-regenerative to amplify well at short wavelengths.

The first WIRELESS AGE reader who gets this combination working properly will be awarded a free and complete assortment of bakelite wavelengths.

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Mr. R. P. V. Brudny of New York writes: "I have an Autoplex receiver and am securing fairly good results with it. I have attempted to add an amplifier, but have not been able to secure as good results. Can you give me any dope on this receiver and how I may add the amplifier without causing the set to cease working?"

The autoplex is, of course, a modified super-regenerative receiver—at least the name is modified. For causing the tube to oscillate at radio frequencies, variometers are included in the plate and grid circuits. For the low frequency oscillation, a large honeycomb coil is in series with the grid while the phones or "speaker" or primary of the first audio frequency transformer serve as the corresponding plate inductance. The impedance of the latter must be high enough, depending upon the tube characteristics, the plate voltage and the value of the grid inductance to cause the low frequency oscillation. If anything is done to lower this impedance or throw it out of tune with the grid inductance, the tube will not oscillate at the low frequency. For this reason condensers across the low frequency plate inductance are not advisable; and if the plate inductance is the phones and they are worn on the head, the extra capacity across them

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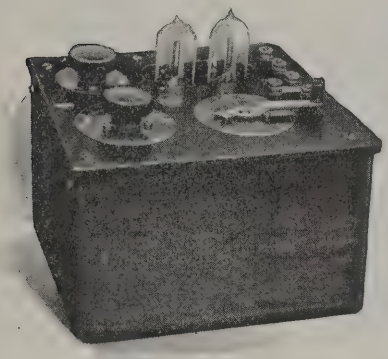

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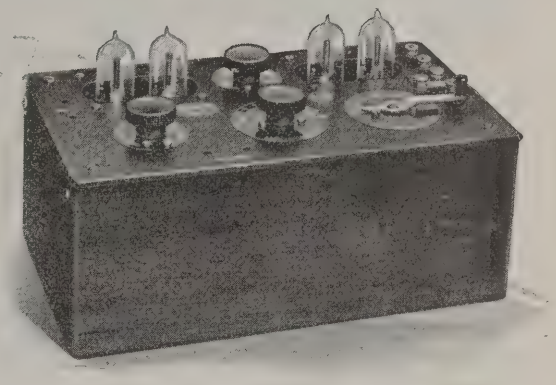

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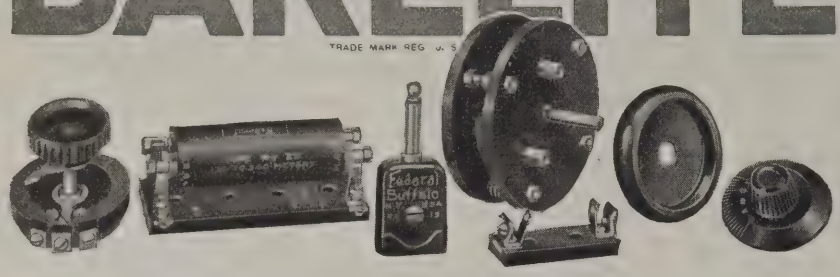

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and from them to ground will have a similar effect. Likewise, if an audio frequency transformer, the primary of which has excessive distributed capacity is used, the tube will not oscillate at the low frequency.

All of this means that using the low frequency output for the dual purpose is not reliable. It would be better to include a coil similar to that in the grid circuit in series with the plate variometer and the low frequency output—the latter would then be not at all critical.

It may be seen that we could still further modify the already much modified, but little changed "super" by replacing the grid honeycomb coil with a pair of phones—and so on.

Audio Frequency Howl

Mr. Irving Wiebl of Brooklyn, New York, writes: "I have a standard detector and two stage amplifier connected to a regenerative tuner; an 'A' battery potentiometer is used to regulate the 'B' battery voltage. Now when I have the slider of this potentiometer at any point other than either the negative or positive ends an audio frequency howl is produced that completely drowns out signals. The megative side of the 'B' battery is connected to the slider. What is the cause and how may I eliminate the howl? Also, just what is the action of the potentiometer in this circuit?"

From your description of the trouble we believe the howling is caused by the resistance coupling common to all three tubes when the slider of the potentiometer is adjusted to include resistance between the negative terminal of the "B" battery and either side of the filament. A large, 5 mfd. fixed condenser shunted from the slider to one side of the filament will undoubtedly fix matters. Better still, use a separate detector plate battery; bring its negative terminal to the potentiometer slider, but bring the negative terminal of the amplifier "B" battery to the positive side of the filament.

About the action of the potentiometer; its purpose in this circuit is to serve as an adjustment of the detector plate voltage. Consider that the "B" battery in a simple detector circuit has a voltage value of 18; if the negative terminal of this battery goes to the negative side of the filament the effective plate voltage will be 18. But if the negative "B" is connected to the positive "A," the effective plate voltage will be 18 plus the voltage of the "A" battery; with the latter of 6 volts the plate voltage would be 24. By placing a potentiometer across the "A" battery and bringing the return lead of the "B" battery to the slider, any value between 18 and 24 may be secured.

Incidentally, as most detector tubes work best at about 18 volts, the detector plate battery should have a tap at 14 volts.

In considering the action of the potentiometer one must remember the position of the rheostat in the filament circuit. If it is in the negative side the plate voltage is reduced below the "B" battery value to an amount equal to the drop across the rheostat (when the slider is at the negative side of resistance). This fact explains the action of the rheostats in a radio frequency amplifier because when they are adjusted the effect is similar to moving the slider of the potentiometer, and because of this, many people have erroneously been led to believe that adjustment of the R. F. filament current is necessary for good results.

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Tuning a Variometer Receiver

R. V. K. writes: "I have a regenerative receiver composed of two variometers, a variocoupler and a UV-200 detector tube. A great deal of difficulty is had in tuning this set. Are there any suggestions which would enable me to master the controls?"

It is possible to give pages and pages of operating suggestions, but whether or not they would enable you to master the controls is rather difficult to say.

To start, it's well to realize the relative importance of each control and to have some knowledge of its action in the receiver. The grid variometer is first—let us call it instead the "wavelength selector" for that is its purpose—to choose the particular wavelength that is to be received.

Next is the plate variometer or "regenerative control." This is the jigger that means so much in strength of signal, but which, if handled improperly, results in squealing and howling and terrible distorted reception.

The other controls, the primary switch or switches, the coupling of the variocoupler and the rheostat knobs are secondary in importance. In general, they can be set and left in one position—at least do not bother with them till later. Set the coupling at a mid point between minimum and maximum—that is, so the planes of the rotor and stationary windings are at about 45 degrees. Fix the primary inductance switch to include about 20 turns of wire between the aerial and the ground. Adjust the knob of the detector rheostat till the tube (UV-200) filament lights brightly, but not so much as to cause a "rushing" noise in the phones.

Now, set the plate variometer anywhere and slowly move the wavelength selector until a station is heard; center this control for maximum response and then move the regenerative control for best results. At the same time make slight readjustments of the wavelength selector. Thereafter for other stations, keep the wavelength and regenerative controls in step with each other; sort of balancing the two for best results, remembering, however, that the wavelength selector and the regenerative controls have special purposes. That is to say, if the receiver is oscillating so that the carrier wave of stations can be heard, adjust the regenerative control. Do not bother the wavelength adjustment or the amplifier rheostats.

We believe that merely thinking of the two main controls in terms of what they do rather than their technical description will go a long way in helping one to tune properly For instance, imagine calling the brake and throttle in an automobile by lengthy and technically descriptive names—one might "step on it" instead of stepping on the brake—and that wouldn't be so good—would it?

Amateurs Shake Hands Across Atlantic

(*Continued from page* 51)

It is certain that reliable two-way communication would have been resumed on the following night had it not been for the fact that the atmospheric conditions were decidedly poor. There was plenty of static and noise. F8AB changed his wave length and apparently had trouble. His note was

A NEW PRODUCT

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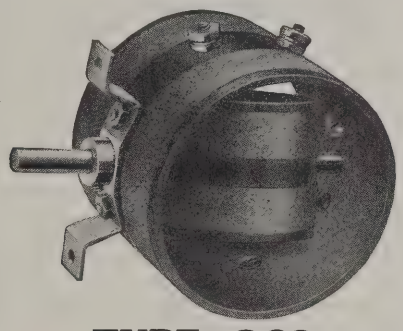

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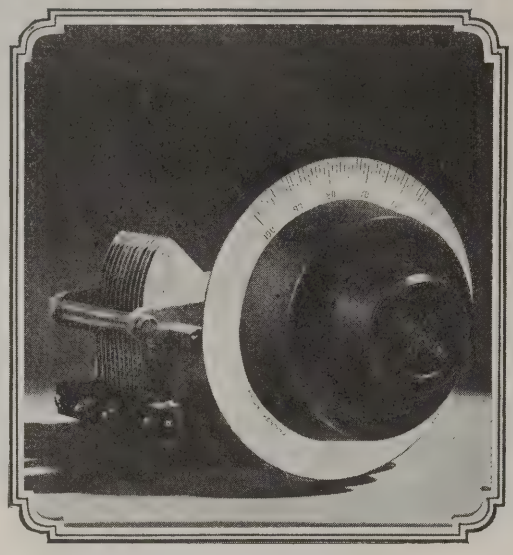

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poor and his signals faded badly. Although a schedule had been arranged, he exchanged call with 1MO at midnight and that was all except that 1BGF in Hartford was also listening and he managed to copy F8AB as did also 1XAM in South Manchester.

Even the holiday did not keep the amateurs on either continent from making a third attempt and Thanksgiving night found Deloy and Schnell once more at their transmitters. This time F8AB was right on KDKA's short wave, about 103 meters, and he could be heard distinctly only when the broadcast station was fading out. 1XAM succeeded in connecting with him twice and at 10:40 asked Deloy to change his wave length. However, he was not heard again.

There is a strong opinion among A. R. R. L. officers that the short wave made the transoceanic accomplishment possible and that it might have been extremely difficult on a wave length of 200 meters owing to the interference from other stations in this country.

Design of Loop Antenna

(*Continued from page 38*)

reliable, however, and if used, the connections should be frequently inspected to see that there is satisfactory contact. If the wires of the loop terminate at the lowest corner flexible connections can be dropped at that point to the set, with enough slack in the wire to permit the rotation of the loop for one revolution.

In connecting a loop of the "plane" type—figure 1a or 2a—always connect the wire from the outer edge to the portion of the circuit nearest ground potential and the inner end of the loop to the grid. This precaution will insure a larger wave-length range, as the distributed capacity of the coil is materially reduced. There appears to be no advantage in connecting a "box" type loop in any particular way, as the same is more or less symmetrical.

Improve Your Set

(*Continued from page 57*)

arranging of the units and reduces the possibility of regeneration from cross leads running from the various units. This is very important. It is to be noted that in figure 9 the connections are very short. Maximum efficiency is obtained in this way.

TUBES

I have obtained best results by using the UV-200 tube as a detector and the new UV-201A tubes as amplifiers. Approximately the same volume of sound can be obtained with three WD-12 dry cell tubes. Instead of using dry cells to operate the tubes—because it was necessary to have the

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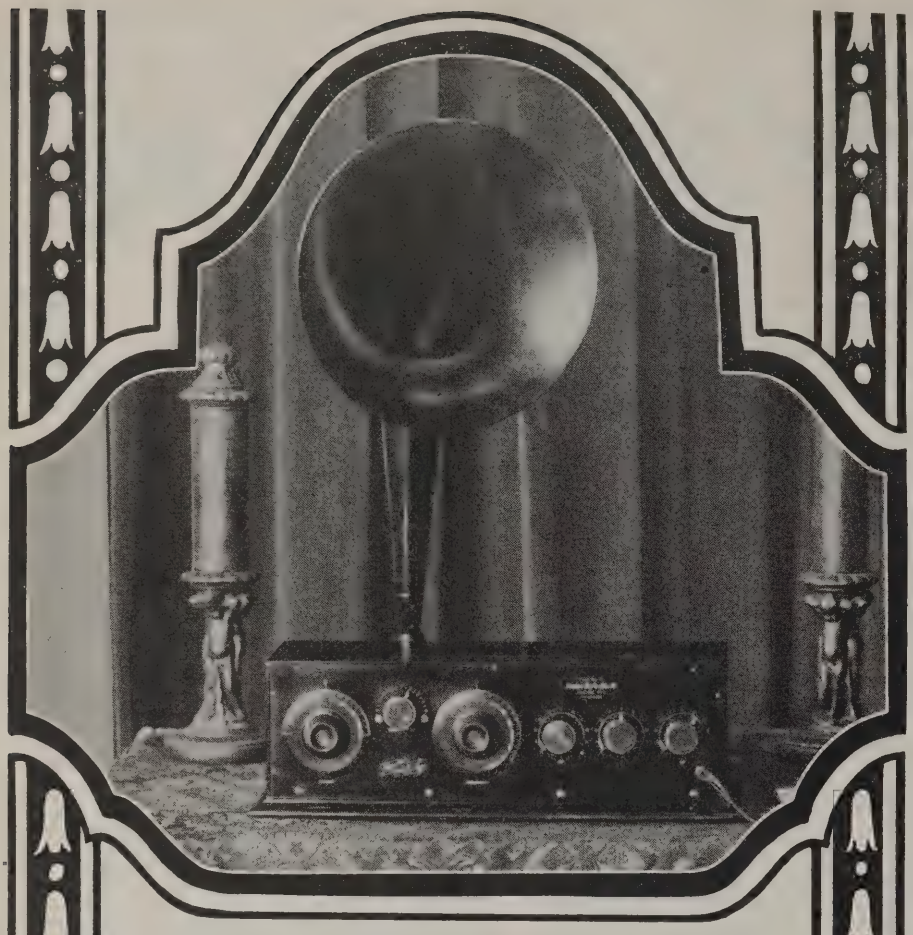

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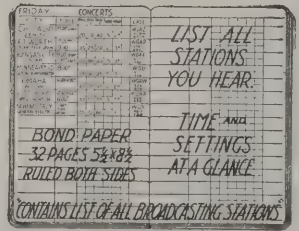

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storage battery to operate the Western Electric Amplifier tubes—I used the arrangment described in figure 11. It is clearly shown that the WD-12 tubes were operated from one cell of the battery (2 volts) while the W. E. amplifier was operated from the three cells of the 6-volt battery. When using the storage battery in this way do not use one cell at all times because it will become discharged to a point which will be considerably lower than the other cells and it will not be possible to fully recharge it. Change cells often. In other words: Use the first cell for a while, then the middle cell and finally the last cell—repeating the process until the battery requires recharging to operate the power amplifier.

The two-volt battery will not damage the tubes if the rheostat is properly operated. It will be found in most cases that it is only necessary to barely turn on the rheostats in order to obtain good results. Never use the rheostats past the "half in" position.

Colpitts' Push-Pull Circuit

(*Continued from page* 35)

horn for signals of an intensity that almost knocks the loud squealer from its resting place. Engineering ability and many hours of research are the necessary requisites in the planning and designing of an effective loud speaker. It is therefore impossible to get a five-dollar reproducer that will be in any way as good as the higher priced ones manufactured by reputable concerns.

However, the best loud speakers on the market today do not give perfect reproduction. The loud speaker is practically the only unit in the radio art that has not been radically changed by some new invention. It still uses the principle of a magnetized iron core and diaphragm. Unless some one can discover a new principle in sound reproducers, perfect quality will not be obtainable from the receiving system.

Tube Overloading and Its Remedy

Since the advent of the dry cell tubes, many of the radio fans have found their use very convenient. The advantage of employing them lies in being able to design a compact set without needing the cumbersome storage battery with its continual need for charging and keeping in order. The big disadvantage lies in not being able to obtain a very loud signal without getting distortion due to tube overloading. Many of the fans are still clamoring for the loud signal as they are not satisfied with one of comfortable intensity.

To study the reason for distortion on a loud signal when using the dry

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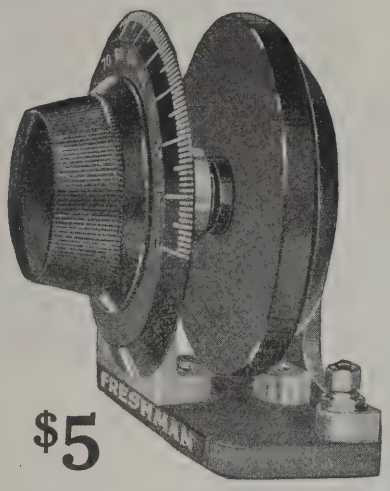

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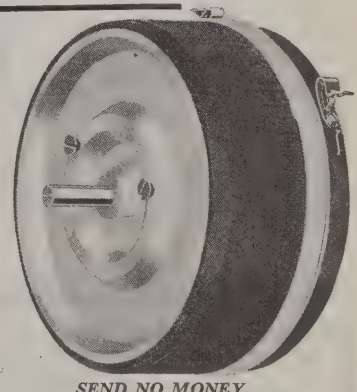

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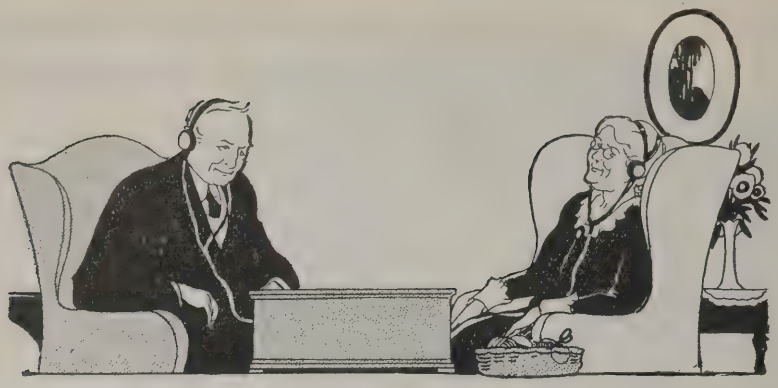

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General Electric Company
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GENERAL ELECTRIC

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"POTENTIOMETER"
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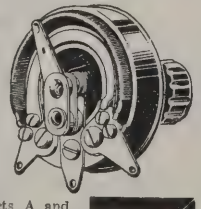

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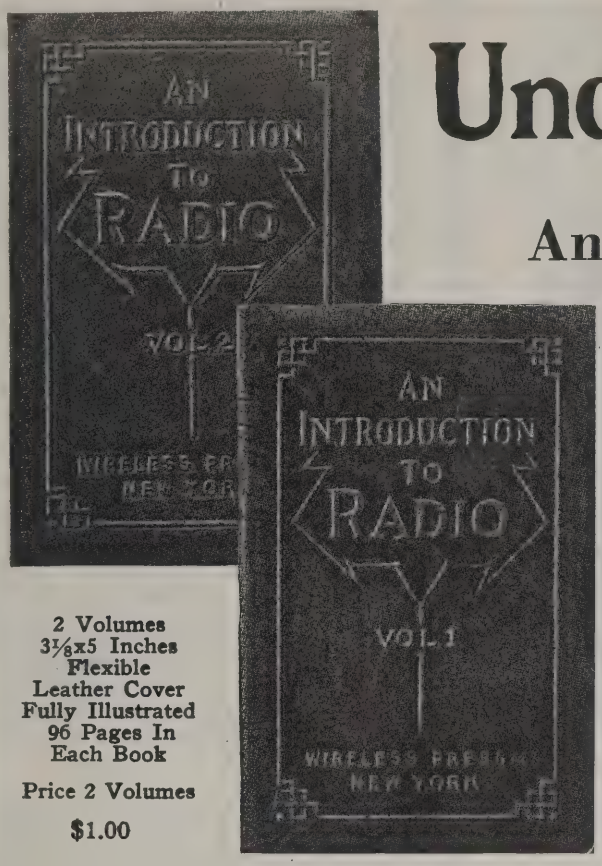
cell tube, it is necessary to refer to figure 3 which is the characteristic curve of this type of tube.

When the dry cell vacuum tube is normally operated as an amplifier on 90 volts plate battery it requires a negative voltage of 4½ volts in order to bring the pivot point "0" at the center of the straight portion of the characteristic curve. This gives a D.C. plate current of 2 milliamperes. A loud speaker signal of fair intensity requires a current through the loud speaker of about .8 milliampere. The voltage impressed on the grid to produce this change is 2½ volts. As seen from the curve, the grid swinging 2½ volts each side from "0" will produce an equal plate current change of .8 milliampere on each side of "0" as in "A," figure 4. However, in order to produce a good loud signal, a plate current change of about 2 milliamperes is required through the loud speaker. To produce this change, a voltage of 5½ volts must be impressed on the grid. But due to the characteristic of the curve, 5½ volts impressed on the grid to the left of "0" will produce a plate current change of only 1.6 milliamperes with a 2 milliampere change when the grid swings 5½ volts to the right. This unequal change in plate current causes distortion as in "B," figure 4. Additional distortion is also obtained due to the fact that, when the grid swings 5½ volts to the right of "0," it becomes charged 1 volt positive, causing it to draw current. The effect of this is to flatten the upper peaks of the waves. The above results clearly indicate that a dry cell tube is not designed for a very loud signal as forcing or overloading the tube will cause distortion. The Radio Corporation of America emphasizes this point in the circular issued with each dry cell tube.

However, distortionless amplification can be obtained by using two tubes in a special arrangement. This arrangement is known as the "push-pull" circuit and was invented by Colpitts of the Western Electric Company. The circuit is shown in figure 1. There are two special transformers used. The input transformer has two secondaries while the output transformer has two primaries.

Distortion is eliminated in the "push-pull" circuit in two ways. First, each tube takes only half of the input load. If a voltage of 5½ volts is impressed on the secondary of the input transformer, each tube will have but 2¾ volts impressed on the grid. This will cause the grids to operate on the straight portion of the characteristic curve and no distortion will occur. As the plate of each tube is connected to a primary winding of the output transformer where both are coupled to a common secondary, the total energy in



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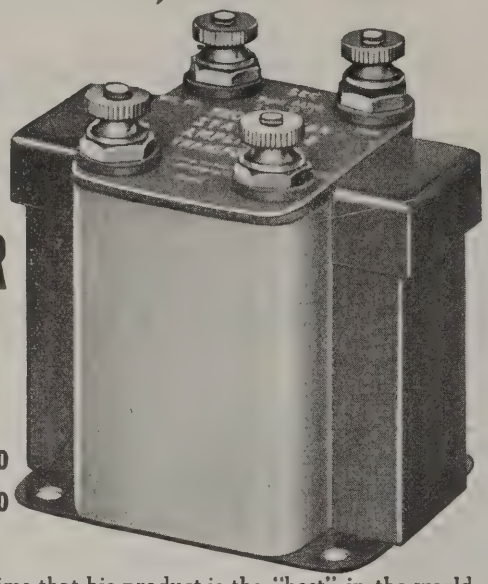

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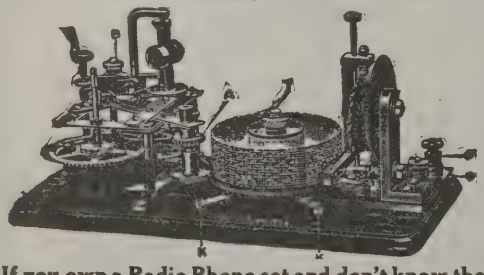

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the secondary will be the product of the energy of the primaries.

The second reason for using the "push-pull" circuit is that the fundamental waves through the output transformer are additive and any harmonics present in each primary will be out of phase, therefore neutralizing each other in the secondary. As harmonics cause distortion, further advantage is gained by the use of the "push-pull" circuit.

The input and output transformers for this circuit are already available on the market. Care should be taken in purchasing an output transformer with a secondary that has an impedance equal to that of the loud speaker. If the secondary winding has a low impedance, then a step-up transformer must be used as shown in figure 1A.

Should any one find it difficult to secure these transformers, standard audio frequency transformers may be used as shown in figure 5 and practically the same results will be obtained.

A Radio Operator Sees the World

(*Continued from page 33*)

come is greater than that of a man ashore receiving twice that amount. And ten to one the man ashore has not had as pleasant work nor the opportunities for self-improvement that radio operators have.

WHAT DOES THE OPERATOR'S JOB COMPRISE?

Beyond the primary task of sending and receiving, the up-keep of the apparatus is a very important part of the radio operator's work. To be a real man at the business he must know, not only the theory, but the practical working of each part. It must be kept in good running order the same as any other mechanical or electrical machinery so as to get the best results and prevent undue deterioration.

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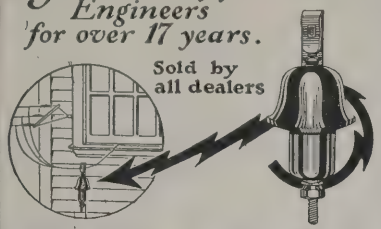

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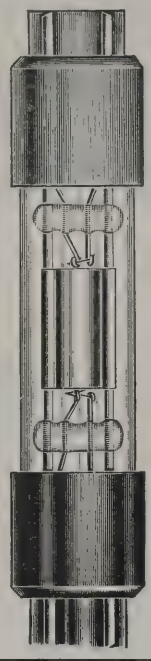

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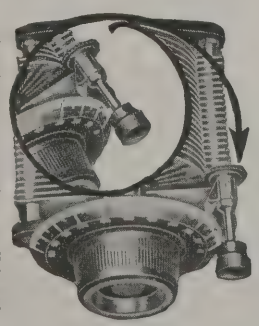

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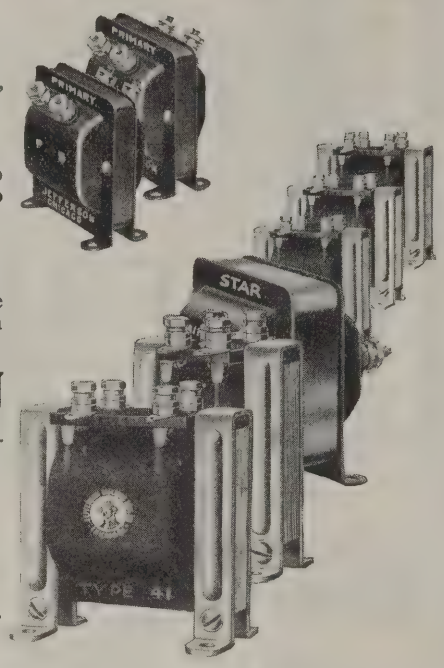
USE A JEFFERSON

"that is made by a company who have specialized in this field for more than a generation"

USE A JEFFERSON

The Name JEFFERSON is Known Wherever Transformers are used.

You are invited to write our Radio Engineering Department for amplification data. Attractive descriptive literature is also available. This service is gratis.



JEFFERSON ELECTRIC MFG. CO.
431 S. Green St., Chicago

NO MORE CABINETS

JUST APPLY FLAT MAHOGANY OR PLATE GLASS COVERS TO THE NEW

Quinby Radio Frames

(PATENT APPLIED FOR)

SIZE "A" for panels 7" high, each $0.85
SIZE "B" for panels 5" high, each ..... .85

QUINBY RADIO CONSTRUCTION COMPANY

Subway Building
587 West 181st Street NEW YORK

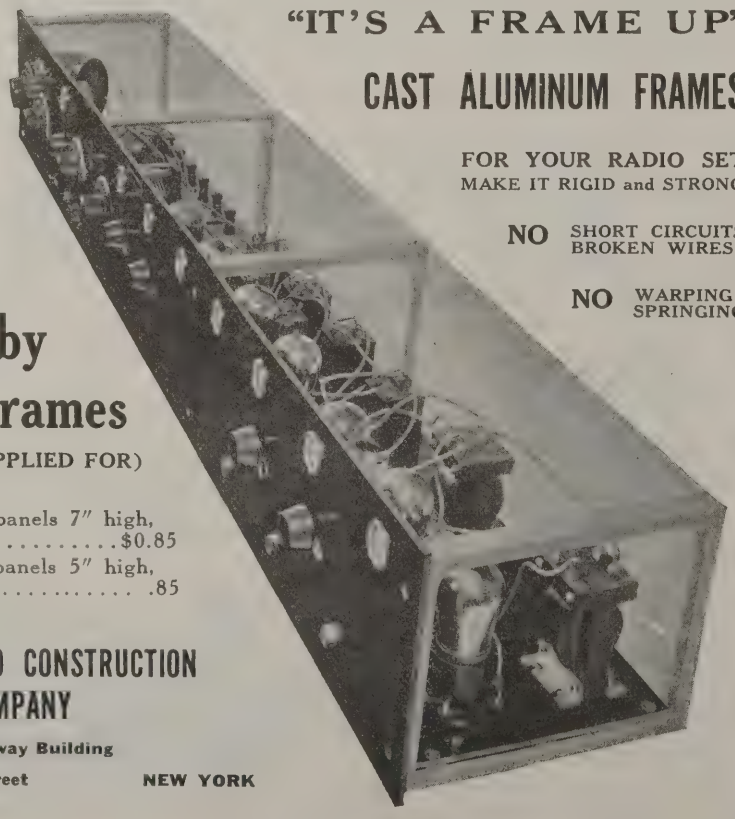
"IT'S A FRAME UP"

CAST ALUMINUM FRAMES

FOR YOUR RADIO SET MAKE IT RIGID and STRONG

NO SHORT CIRCUITS BROKEN WIRES

NO WARPING SPRINGING



always be keyed up to the highest state of efficiency and ready for use at a moment's notice. The operator must know how to adjust the set so as to immediately obtain the maximum of power and the broadcast wave.

When life and property is not in jeopardy, radio is used in connection with government matters, such as the reception and transmission of hydrographic information, weather reports and government traffic. Next in order are messages pertaining to the movements of the ship, the cargo or the captain's official business. Later come personal messages of passengers or members of the crew.

It is plain, therefore, that the radio operator's work is of great importance. Upon him rests a heavy responsibility; first, a responsibility for thousands of dollars worth of equipment; second, the much larger responsibility involved in handling efficiently a traffic upon which may depend big business transactions, national affairs and precious human lives.

Radio Breaks Arctic Silence

(*Continued from page 28*)

The receiver is a three-circuit regenerative tuner, "Paragon" type RA-10, with a detector and two steps of audio-frequency amplification only being used, the receiving tubes being of the standard type and using a storage battery for heating the filaments.

Many false reports have been circulated about the *Bowdoin*. One was to the effect that the expedition was in peril. This was quickly denied, however, by the schooner's operator upon being advised of the report.

The first instance of radio forgery is believed to have been a case where some unknown person, impersonating Captain MacMillan, spoke into a radio telephone transmitter. The message was picked up by a Philadelphia banker, who believed he was hearing the radio station of the expedition. As the *Bowdoin* carries only a telegraph transmitter and has no apparatus aboard for the transmission of voice, this was of course impossible.

Donald Mix has assuredly lived up to his previous good radio record. Aboard his ship several records have been made. A message was telegraphed by him eleven degrees from the North Pole to an amateur station in Honolulu, Hawaii, and an answer received. In addition to this through Operator Mix's skill, music broadcast from Glasgow, Scotland, has been picked up and enjoyed by the crew of his ship. Winter may have other records in store which will astound the radio world.

THE WIRELESS AGE

"America's Foremost Radiophone Review"

VOLUME XI APRIL, 1924 NUMBER 7

The Radio Sets of 1924

Aladdin has lost his Wonderful Lamp,
And the Magic Carpet is gone;
The Singing Tree's leaves are withered and dead,
And the Wishing Well is forlorn.

But what do I care for the things that are past,
The dreams that are dead and no more?
For a Genii's asleep in my brown carved box,
And will wake when I open the door.

He sleeps all day, through its toils and its cares,
Through its rain and its sun and its sleet;
But at night, he rides out on the harp of the wind,
To lay all the world at my feet.

The beauty of music, the rhythm of song,
And the jazzing blues of the air,
All are mine, for the Genii has brought them to me,
As I sit in my easy chair.

The 1924 Offering of the C. D. Tuska Co.

I jostle with grandeur and elbow with pride,
And meet all the great of the earth;
I weep with the sad at the parting of ways,
And laugh with the glad in their mirth.

The man on the stage, and the man in the church,
Give to me of the best that is given;
The poet, that lifts up the soul from the clod,
And the saint, with his message of heaven.

The silver-tongued orator speaks but to me,
As the eager crowd surges and clings.
Though I've never a plume nor a velvet gown,
I sit at the table with kings.

Aladdin has lost his Wonderful Lamp,
And the Magic Carpet is dyed;
But what should I care, with my brown carved box,
And the Genii that lives inside!

—VIRGINIA FRAZER BOYLE.

COME with us, reader, into the next few pages in which we have collected some of the interesting radio receivers that 1924 is offering to radio fans.

Past research and engineering skill is all embodied within attractive cabinets. In fact, this four-page presentation of the year's offering has suggested to us the splendid possibility of artistic photographs of sets IN THE HOMES OF OUR READERS.

Whatever the set, however it may resemble a laboratory model, it ought to be a part of the furnishings.

So we challenge you to a contest!

Can you do better than we have done here?

Prizes will be awarded for the best photographs illustrating The Beauty of Radio in the Home. See page 47 for full instructions.

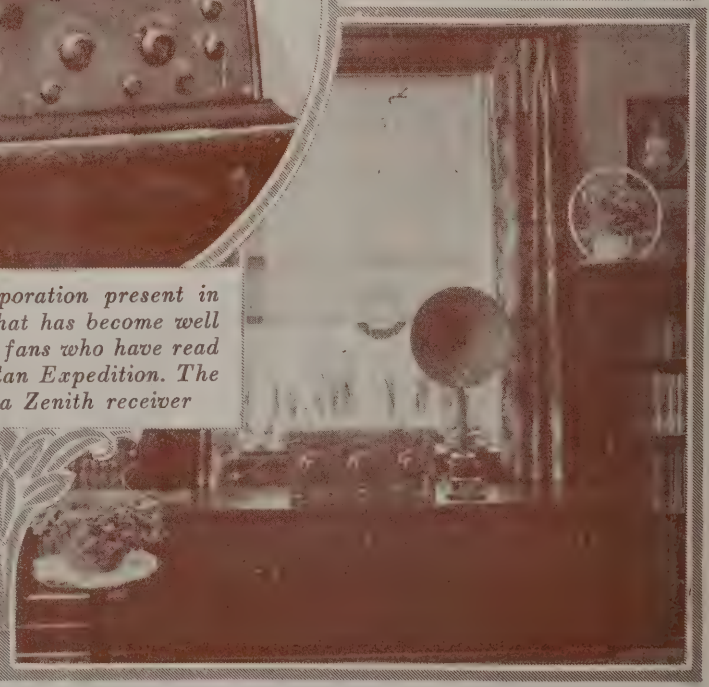
The Eagle Neutrodyne has found its way into the homes of many discriminating folk. This home setting exemplifies the offering of the Eagle Radio Co.

The Radio Sets of 1924

American Radio & Research Corp. offer the Amrad Jewel as an enlarged copy of an old Italian Jewel Casket with Grecian dancing figures in bold relief on the doors and sides

R. E. Thompson Manufacturing Co. embody their reputation in their Neutrodyne. Mr. Thompson is an old timer in the radio field, formerly manufacturing for the Government

Zenith Radio Corporation present in this set a circuit that has become well known to all radio fans who have read about the MacMillan Expedition. The "Bowdoin" has a Zenith receiver



This Freed-Eisemann NR-5 Neutrodyne indicates the advance made by Joseph Freed who was prominent in the early rush to supply the huge demand for receiving apparatus when broadcasting was first established, and whose popular receivers are well known

Garod Corporation has been able to boast of many Garod Receivers in attractive homes such as is pictured here, the home of Mr. G. M. Payne, Kansas City, Missouri. Mr. Davidson of the Sterling Radio Co. installed the set making it accord with the furnishings

The Radio Sets of 1924

Federal Telephone & Telegraph Co. Set De Luxe, in mahogany, trimmed with sterling silver

Adams-Morgan Co. embody in this Paragon Model 3, the same circuit that made the Paragon RA-10 famous, and still is hanging up records

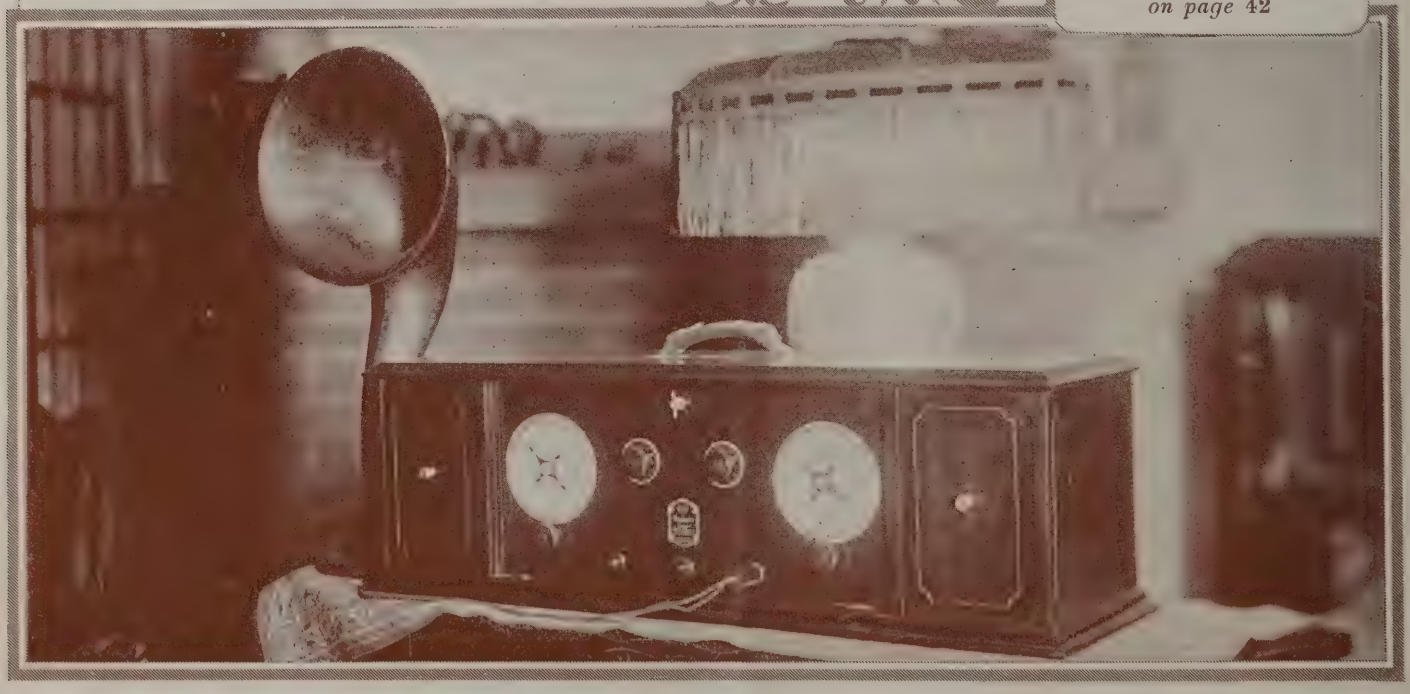
A. H. Grebe & Co. offer in this Grebe Broadcast Receiver the product of their development of the original set which was built for amateur use before the advent of broadcasting

The RCA, Radiola X is an ultra refined receiver designed to be in accord with the practical and aesthetic requirements of a living room setting and still afford clear and selective reception

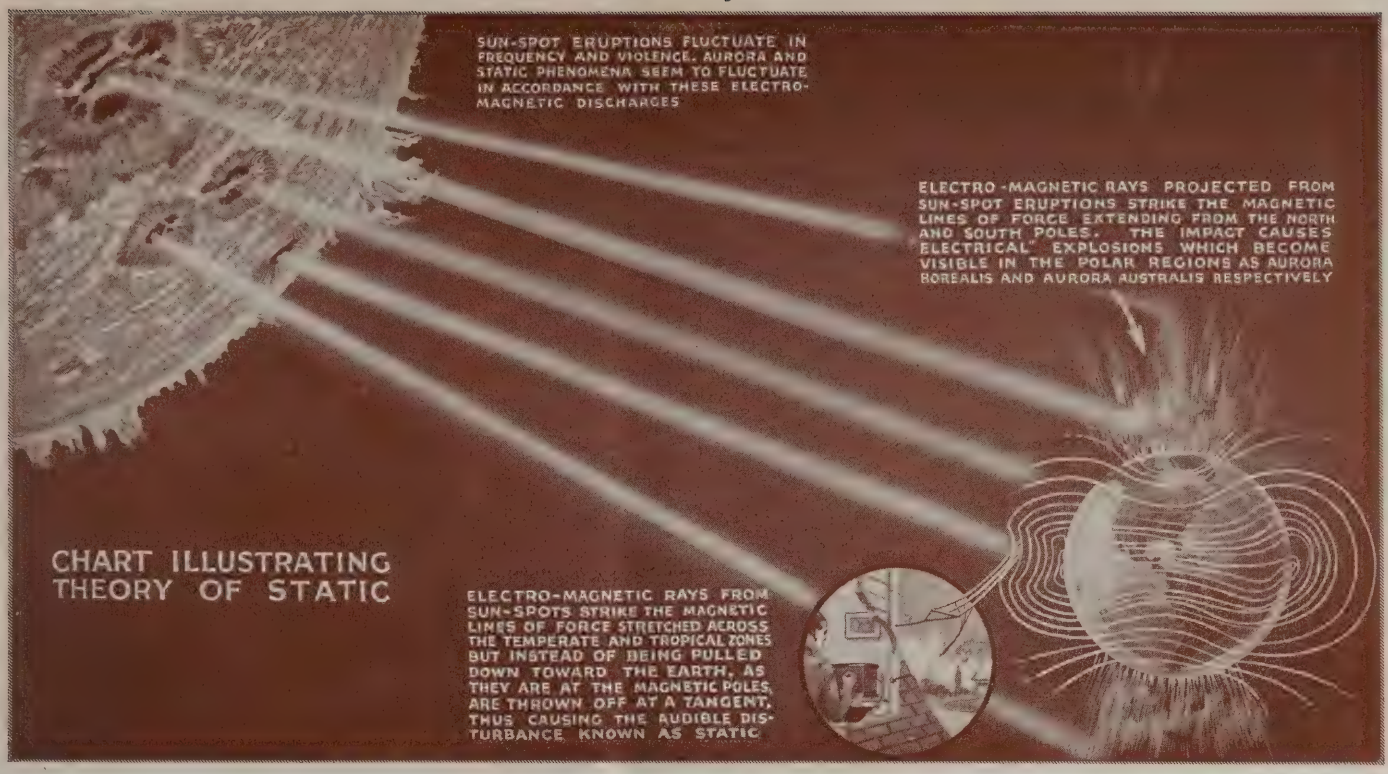
The Radio Sets of 1924

Colin B. Kennedy Co. offer this self contained set, Kennedy Model V, with trimming and dials done in gold. It lends distinction to the furnishings of any home

This set has been so successfully embodied in a book-case that the storage batteries are not evident. The description of this unique camouflage will be found on page 42



The Radio Corporation of America has presented in the Radiola Super-Heterodyne a semi-portable mahogany cabinet with ornamentation and lines that relates it definitely to the setting of any room in the home. This set is completely self-contained, housing loop aerial, batteries, etc., thus lending itself admirably to any surrounding, whether home or office


SUN-SPOT ERUPTIONS FLUCTUATE IN FREQUENCY AND VIOLENCE. AURORA AND STATIC PHENOMENA SEEM TO FLUCTUATE IN ACCORDANCE WITH THESE ELECTRO-MAGNETIC DISCHARGES
ELECTRO-MAGNETIC RAYS PROJECTED FROM SUN-SPOT ERUPTIONS STRIKE THE MAGNETIC LINES OF FORCE EXTENDING FROM THE NORTH AND SOUTH POLES. THE IMPACT CAUSES "ELECTRICAL" EXPLOSIONS WHICH BECOME VISIBLE IN THE POLAR REGIONS AS AURORA BOREALIS AND AURORA AUSTRALIS RESPECTIVELY
CHART ILLUSTRATING THEORY OF STATIC
ELECTRO-MAGNETIC RAYS FROM SUN-SPOTS STRIKE THE MAGNETIC LINES OF FORCE STRETCHED ACROSS THE TEMPERATE AND TROPICAL ZONES BUT INSTEAD OF BEING PULLED DOWN TOWARD THE EARTH, AS THEY ARE AT THE MAGNETIC POLES, ARE THROWN OFF AT A TANGENT, THUS CAUSING THE AUDIBLE DISTURBANCE KNOWN AS STATIC

STATIC

Heavy Static Predicted This Year

Astronomer Believes Static Is Caused By Sun Spot Eruptions; Technical Advances In Reception, However, Will Offset This

By David Todd, M.A., Ph.D. Emeritus Professor of Astronomy and Navigation and Director of the Observatory of Amherst College, Author of "New Astronomy," and Foremost Authority on Cosmogony, Mathematical Astronomy and Related Sciences

FOR over forty years I had been following and studying the phenomena of the polar lights with a faint hope that some day some development would take place in the world which would relate this extraordinary natural phenomena to the business world, so that it would be considered of use to make a thorough investigation of the cause and effects of the polar lights.

The progress of radio and its increasing application to every-day life has, at last, realized this hope, and when the Aerial League of America, close to two years ago, asked me to become the chairman of a committee to study the causes and effects of the auroral phenomena and their solution to the problems of increasing radio traffic, I undertook this work with great pleasure and interest.

I had for a long time seen a relationship between sun spots and auroral displays, but I could not ascertain their actual relationship until I found I could do so by watching for static and fadings in radio transmission and reception.

The radio instruments gave me the means with which to solve this most difficult problem of ascertaining the relation between sun spots and polar lights. Fortunately in doing so the radio instruments also made it possible to secure data which, I believe, will greatly assist in solving some of the most difficult problems of increasing radio traffic, by removing obstacles in the way of better transmission and reception which are due to purely natural phenomena.

David Todd, M.A., Ph.D.

Experiments during the past winter have revealed a relationship between sun spots, the aurora borealis, static as we know it in radio reception and telephone and telegraph interference.

For instance, on December 20, 1923, I discovered a sun spot near the eastern end of the sun and predicted that it would extend and would cause violent auroral displays, which would interfere with wire transmission as well as with radio.

By noon the observations showed that the spot had developed into a group, and at 3 p. m. so violent was the

Actual photograph of sun spot eruptions

solar activity that observers counted five engulfed in a cyclonic area, the diameter of which would stretch twice around the earth at the equator.

This was similar to the unexpected solar outburst that my party caught at Coral Gables, Miami, in 1922.

As anticipated, heavy static was reported by radio experimenters.

It will also be recalled that during the transatlantic broadcasting test the checking up was delayed because the auroral disturbances disrupted for a while the wire service while it apparently did not interfere with the broadcasting test.

The fact seems to be that at times the auroral discharges interfere only with the wire service and actually appear to help radio transmission, while at other times both are affected.

The auroral trouble experienced by the cable service, during the transatlantic broadcasting tests was due to the sun spots, which caused heavy electro-magnetic discharges and correspondingly heavy auroral displays probably all over the earth.

A number of check-ups and observations were then conducted for a sufficient period to reveal the relationships between sun spots, the aurora borealis, which is actually visible static, and the audible static, known to all radio fans as natural interference in wireless transmission and reception as well as telephonic and telegraphic communication.

One of the sun spots observed was 9,000 miles in diameter, or greater than the diameter of the earth, while the area on the sun covered by the spots is about 45,000 miles.

While only less than one-third the size of the greatest sun spot observed on record—observed in 1858, which was nearly 150,000 miles in breadth—this is a large sun spot, visible to the trained naked eye as a minute black spot on the sun without telescope.

Many years of observations have taught me that sun spots are not always equally numerous on the surface of the sun. At times they may be counted by hundreds and again days and weeks may elapse without a single spot being visible. Then sudden solar eruptions would be observed.

Heretofore it required constant observations to follow what was happening on the face of the sun. Henceforth the radio experimenters will tell us about it before the astronomers have had the opportunity to find it out.

In saying henceforth I may add that my observations have revealed a series of new solar outbreaks, from which we may expect during the year 1924 constant heavy eruptions and corresponding heavy electro-magnetic discharges, with accompanying frequent and brilliant auroral displays.

I predict that during this coming year, radio reception will be most difficult because of heavy static discharges. This checkered reception will be attributable, of course, to the unusual solar disturbance.

But the exact effect on radio transmission and reception, the radio world will tell us six months hence, and their reports may be the most accurate and valuable contribution yet made to the study of solar phenomena in a century.

Northern Lights

By Eugene C. Dolson

The Northern Lights
Flicker and flame
Over weird Polar snows
On these late nights
When there is no moon.

I think they are dancing girls;
For I catch the gleam
Of their loose golden hair,
And I see their slim forms
Flitting about, here and there,
On the wide floor of the sky.

—From Town & Country.

What Is Static?

Professor Todd says:

THAT form of static which is due to electro-magnetic discharges and is audible to the radio is no doubt the result of aurora phenomena which are invisible to the astronomer, therefore radio, the latest development of science, has become the means of aiding astronomy which is the oldest branch of science and making it possible to solve mysterious phenomena which have puzzled the scientists for ages.

What Is the Aurora Borealis?

While we have no definite knowledge of the construction and composition of the ether or medium that fills space at different heights above the earth we can experiment and seek to reproduce the auroral effects.

The simplest assumption justified by the phenomena is that the auroras are caused by solar discharges or vagabond electro-magnetic discharges; the term "electro-magnetic" being used here in the broadest interpretation, to include electric rays and magnetic phenomena.

There is a great similitude between the polar lights and the Lenard Rays, which are produced by directing a stream of cathode rays against an orifice in the vacuum tube closed by a thin aluminum window. A transformation takes place and instead of traveling in bundle shape as cathode rays will, the transformed rays will now diverge in all directions from the aluminum window, to be quickly absorbed by the air, just as polar light displays seem to be.

It would seem logical that if highly magnetized metals absorb less X-rays than the same metals unmagnetized—demonstrating that magnetism resists penetration—the magnetic polar re-

Spitzbergen Radio Station located on a group of islands in the Arctic Ocean. Beyond the water, in the background, are mountains covered with ice throughout the year. Above is a glorious display of the Aurora Borealis

Admiral Robert E. Peary, discoverer of the North Pole. In the course of his Arctic explorations, he observed hundreds of auroral displays and many from his island in Maine. He stated that the auroras were not the exclusive privilege of Arctic explorers, adding that he had seen Northern Lights of greater beauty in Maine than he had ever seen beyond the Arctic Circle

At the point of maximum aurora display in the polar region

Raold Amundsen, discoverer of the South Pole, and now trying to reach the North Pole. He says that he formerly believed that auroral displays are accompanied by audible noises. While walking on the deck of his ship he heard a crackling, rushing noise. He stopped, held his breath and listened. No noise. He resumed his breathing, and again, the noise. He then discovered that his breath, frozen by the intense cold, was the real cause of the crackling, rushing sound!

gions, where the earth's total magnetic forces are centered, should be the zones of most intense auroral displays.

The electrician and the physicist can assist by trying to duplicate the auroral, phenomena in the laboratory by passing electricity through magnetic fields and rarified air and in other ways.

If Professor Stoermer is correct in his deduction that the auroras are made up of cathodic rays, then the magnetic polar regions would be the best laboratories for the study of the phenomena of atmospheric electricity, about which we are still ignorant, because the cathode ray particle appears to be the real electron, and the real electron is the basic unit of electricity.

Data compiled from the reports of many authorities indicate direct relationship between the polar lights and the magnetic, electric, and atmospheric disturbances which affect radio transmission.

The fact that the number of auroral displays often is over one hundred annually, and the phenomena that prevail during the displays affect radio transmission, make it advisable to make available to radio experimenters the data given me by the famous explorers, the few who have lived close to the centers of auroral displays.

Professor Carl Stoermer, the Norwegian scientist who has been awarded the Jansen medal by the French Academy of Science, after living for twenty years in arctic regions studying the northern lights says that the aurora borealis consists of cathodic rays, which are analogous to radium or to Roentgen rays. They are composed of electric particles emitted by the sun at a speed of many thousand miles per second, and so small that several millions placed side by side would not cover an inch.

Henry Woodhouse, president Aerial League of America, demonstrating magnetic phenomenon

It is the magnetism of the earth which draws these electric rays to the dark regions of our planet, hence they are only to be witnessed near the arctic and antarctic regions, the maximum zone of frequency being 70 degrees of latitude. The large majority of auroras occur from 60 to 75 miles from the ground.

Were it possible for radio fans to view the entire earth when the receiver registers the clicks and rattlings of "static" and "atmospherics" they would probably find that polar lights are flashing their dazzling streamers from points ranging from 60 to 100 miles above the north and south polar

(*Continued on page 64*)

The Broadcasters

The Public Pays

Does It Get the Radio Music It Pays For?

By Paul B. Klugh

Executive Chairman of the National Association of Broadcasters

IT seems a great pity that in these comparatively early days of what is destined to be the greatest industry in the world, there should be an attempt on the part of a small organized group—the American Society of Composers, Authors and Publishers—to commercialize the broadcasting of music. This American Society of approximately three hundred, of a known list of 6,500 composers, authors and publishers, insists that the Radio Public be denied their music, unless expensive license fees be paid to their organization by broadcasting stations. As the broadcasting stations are not being paid to broadcast, many of them naturally feel that the demanded payment is an imposition and will not pay it.

The main issues have been confused and camouflaged to such an extent, that a plain statement of facts about broadcasting is needed.

Radio is absolutely dependent for its maintenance, nay, its very life, upon public interest, and if the public continues to be denied any music that it wants, radio will suffer, not only from an entertainment angle, but from the commercial standpoint as well. If any group is permitted to attempt to corner the market, to dictate terms, to say what should, or should not be broadcast unless certain sums are forthcoming, the time will assuredly arrive when many broadcasting stations will be compelled to shut down. This has already happened in several instances.

Not only does the group which would rule and control the broadcasting of music, attempt to dictate to broadcasting stations, and through them to the public, but it also seeks to stir up dissension among unions to which musicians belong, going so far as to distribute propaganda among vocalists, instrumentalists, and other performers that they demand payment for broadcasting.

Further than this an organization of actors has advised its members that they shall not broadcast unless payment be forthcoming, and the larger vaudeville circuits have advised all actors playing on their circuits that they must not broadcast whether they get paid or not! So from every angle efforts are being made to hamper broadcasting in America, and in connection therewith to dictate terms. In the final analysis, it is the radio public which is being deprived, and which would further be deprived, if it were not for the active steps already taken by the National Association of Broadcasters.

After all, it is the public which pays. The public has paid for its music—and should get it. The public has already invested $200,000,000 in radio apparatus, a sum that should be bringing to them $8,000,000 interest at 4 per cent., or its equivalent in entertainment value! And the public will continue to invest in radio apparatus, in accessories, batteries, tubes and other paraphernalia to an even greater extent, providing they get some returns for their money.

The stability of radio therefore depends not only upon the entertainment furnished, but the quality of that entertainment, and it does not seem possible that any group will be allowed to upset, by dictatorial methods, a business that will undoubtedly reach a yearly aggregate of half a billion dollars.

Untrammeled, an avaricious group would not only interfere with a full return on the great amount of money already invested, but would also endanger the commercial interests of many firms who have large sums invested in manufacturing plants. It would have a decided tendency to cause a horde of small dealers and others who make a living from radio, to suffer. So, from many angles, no group should control the situation.

Propaganda advanced by the American Society of Composers, Authors and Publishers is to the effect that it would be ridiculous for a café to hire a well-known orchestra without salary, under the suggestion that playing at the café would further popularize the orchestra, and cause a greater demand for its services elsewhere. They say it is just as ridiculous for broadcasting stations to suggest the same thing.

An old dodge to prove an argument is to assume a false hypothesis. If at the outset, you state something that is not true, you may prove anything. The conclusion sounds correct, but is just as untrue as the premise assumed in the first instance. The fallacy of the café argument is that radio broadcasting stations have nothing to sell; the café has. Furthermore, we find that the café does not pay the orches-

(*Continued on page 75*)

1. Organized group arbitrary about music rights.

2. Radio popularizes music.

3. Broadcasting advertises talent.

4. Broadcast publicity pays performers well.

5. Broadcast-stations operate without profit.

To Our Readers:

The American Society of Composers, Authors and Publishers and the National Association of Broadcasters were each invited to present their own case in the music copyright controversy.

THE WIRELESS AGE now invites public opinion on this issue. If the response warrants further debate, the same organizations will be asked to again present their cases. They can then answer the public, and each the other.

THE EDITORS.

vs. The Artist

Despoil the Composer?

Clear the Air of "Music Static"

By J. C. Rosenthal

General Manager, American Society of Composers, Authors and Publishers

FAIR Play From Radio—that is the appeal which I make in the name of composers and authors whose lives are devoted to writing the music of the world, confident that when the true facts are brought to light the radio public will readily agree that our position is sound, our cause righteous, and our demands reasonable.

In this brief article I shall endeavor to clear the air of the "music static" and remove the misapprehension which has been created between the members of the American Society of Composers, Authors and Publishers and certain broadcasters, in reference to the restrictions placed upon broadcasting copyrighted musical compositions.

First, I shall discuss the basis upon which the copyright owner of music claims the right to control the public performance, for profit, of his work.

In this country the protection of intellectual effort to authors and composers is found written into the Constitution by the provisions of Article I, section 8, which provides that "the Congress shall have power * * * to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

As early as 1856, Congress recognized the necessity of protecting creators of music by granting to the owners of dramatical works, the exclusive right of public performance; in 1897 similar protection was extended to musical works and the existing Act of 1909 vests in the owner of musical compositions the exclusive right to perform publicly for profit.

It is an incontrovertible fact that broadcasting stations, operated by commercial institutions, are engaged in business for profit, and that unless permission is secured from the owner of the musical work they may not lawfully broadcast any copyrighted music. Further, the Federal Court has so held in a test suit brought by a member of our society against L. Bamberger & Co., of Newark, operating station WOR.

Radio is undoubtedly indebted to music, in a large measure, for its rapid progress. To sustain this contention requires no extended argument. The recent voting contests held in New York and Chicago demonstrated that an overwhelming majority of the radio audience desires a varied program of music. Let it be emphatically understood that there is no desire or intent to deny them their wish, or to in anywise impede or restrict the development of radio; on the contrary, we recognize the important part that radio plays in the advancement of civilization, and we are willing to contribute the music of the foremost composers and authors of the world, asking in return a remuneration grossly incommensurate with the value of our offering.

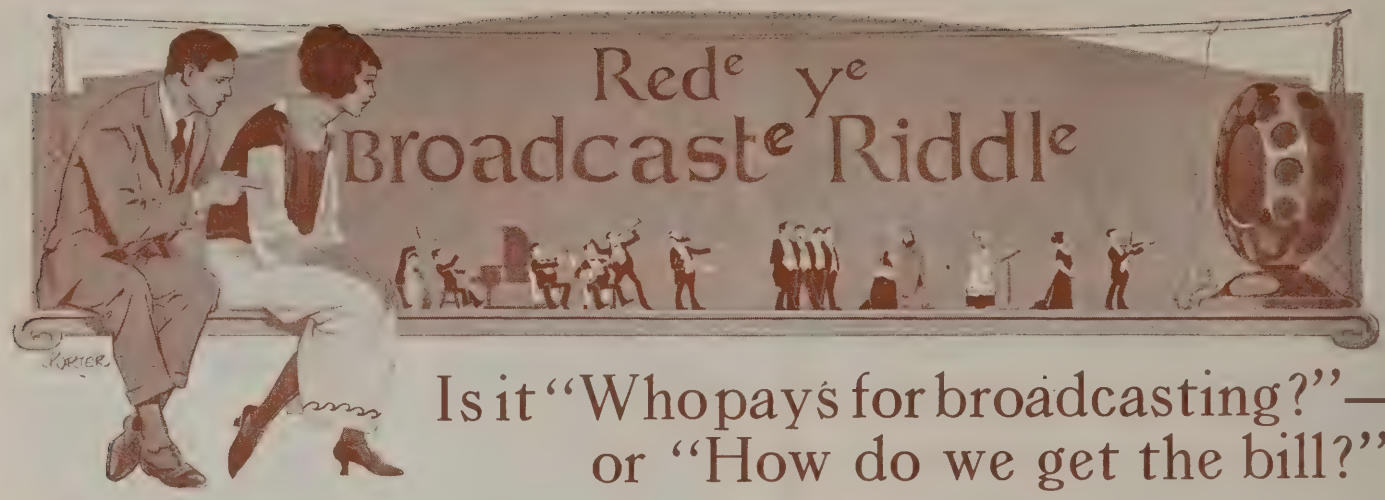
Notwithstanding opinion to the contrary, radio is seriously diminishing the earnings of composers and authors whose livelihood is derived from royalties from the sale of sheet music, phonograph records and music rolls. Since the advent of radio these royalties have been materially reduced—the reason must be obvious to every fair-minded person. The life of a popular song is short. Before radio came into existence, to become familiar with the latest tunes it was necessary to buy the song, the record of the word-roll. Now radio saturates the air with constant broadcasting of these melodies; the former purchaser has become a free consumer, the demand for our products has decreased, and our incomes seriously affected. Is it right and fair, that we should be compelled to suffer without any reward?

Do you know what we ask radio to pay for the privilege of using our creations? In the first place, as to the stations operated by educational, religious and charitable institutions, and amateurs, we have granted permission to use all the works of our members without any charge whatsoever. Do you know that commercially operated stations (excepting those operated by the Radio Corporation of America, Westinghouse Co. and General Electric Co.), are licensed at an average rate of not more than two dollars per day? Do you know that for this two dollars per day, these stations can broadcast the musical numbers written by the foremost composers of America, England, France, Italy, Germany and Austria? Think of it—two dollars per day. Does not this answer the unfounded charge of those opposing our rights, that we are extortioners, that we are trying to "hold up" broadcasters, that we are demanding exorbitant fees?

The American Society of Composers, Authors and Publishers is a bona fide non-profit organization to which all qualified song writers are eligible for membership. The purpose is to assert the rights of the individual members in connection with the public performance for profit of the works which they have created. They ask nothing and expect nothing from the performances of their works, in public or otherwise, if there be no profit intended by the one giving the performance. They control only a small por-

(*Continued on page 74*)

1. Federal Constitution recognizes music rights.
2. Radio indebted to music.
3. Earnings of talent injured through broadcasting.
4. Broadcast stations ought to pay performers.
5. Broadcast stations operate for profit.



Is it "Who pays for broadcasting?"—or "How do we get the bill?"

By William A. Hurd

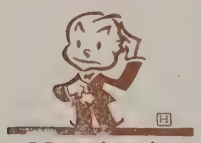
PRIMEVAL man was a rover. His curiosity ever led him over the hill to explore a distant land. But he was a gregarious animal. The need of communication with his kind was inherent.

Oral communication was basic and comparatively simple. But it was limited in range.

Fire beacons and smoke signals, limited in range, were likewise inadequate. A heavy membrane was then stretched across the end of a hollow log, which when struck, would emit sound vibrations capable of traveling to a distance of twenty miles. The membrane of another drum, stretched to the same tension, would vibrate in sympathy with the transmitted sound waves. But the need of a more flexible system for thought transmission and reception became evident.

And it was the discovery of movable type that marked the greatest stride forward in social development. However, while literature progressed toward the era of periodicals, runners and travelers still constituted the principal means of distant communication.

Then the nineteenth century. Magazines and newspapers ran abreast, with steam and gas engine locomotion. Civilization hurried.



Morse's telegraph threatened to annihilate space. Bell's telephone bridged the gap between distance and simple, oral communication.

Civilization paused, breathless, for a moment, and then resumed its mad pursuit of long distance communication, urged on by the discovery of wireless.

And finally, the advent of broadcasting!

* * *

THE WIRELESS AGE installed and operated in the 71st Regiment Armory, New York City, in September 1921, the first broadcast station to transmit a scheduled program by artists.

At that time, KDKA, the pioneer broadcast station of the Westinghouse Electric and Manufacturing Company, at Pittsburgh, had not yet launched a definite program on the air.

In the early days of broadcasting, the transmitting apparatus was usually confined to some remote corner of the laboratory, and programs, in the main, consisted of records played on a phonograph.

Letters from listeners were important. The suggestions volunteered by letters were most helpful during the early chaos that ushered in the great vehicle of entertainment and education. They were tangible evidence of applause from an audience, so vast, that even the most sophisticated artists were inspired to go before the microphone. And artists then were hard to obtain.

Originally, broadcasting was partly experimental; the stations first in operation worked on a thousand-watt power output that naturally covered a tremendous area. The deluge of letters following each program spurred the directors on to greater effort. Suggestions that appeared desirable were followed. Each new success encouraged further embellishments.

And so broadcasting developed to the point where program directors found it necessary to determine just what the public wanted.

How Program Directors Know the Public Wants

Radio has outgrown the whim of any one organization. It has irrevocably insinuated the roots of its service into the heart of the public welfare. It has become a public service.

Broadcasting, as a service to the public, must function as entertainment and education.

Were it possible to establish a definite line between entertainment and education in broadcasting, the attempt to do so would not be justified. Instruction should be presented in such a manner that it entertains. And whatever amuses surely educates in some respect, however obscure it might be. Program directors never forget their obligation to the radio audience, the responsibility of presenting what the public wants without offending, and yet including all the features desired by groups with specific interests.

Program structure, contrary to current belief, is an orderly, systematic gauge of just what the public wants. When broadcasting first staggered to its pinnacle of unique diversion, letters from enthusiastic fans suggested new stunts, and the personnel of broadcast

ACKNOWLEDGMENT

The authorities for statements, opinions, and conclusions of this story are:

W. E. Harkness, assistant vice-president of the American Tel. and Tel. Co.

David Sarnoff, vice president and general manager of the Radio Corporation of America.

H. P. Davis, vice-president of the Westinghouse Electric and Manufacturing Co.

Martin P. Rice, director of broadcasting for the General Electric Co.

C. B. Popenoe, manager of Station WJZ.

J. A. Holman, manager of Station WEAF.

J. C. Rosenthal, general manager of the American Society of Composers, Authors and Publishers.

Paul B. Klugh, executive chairman of the National Association of Broadcasters, and

Austin C. Lescarboura, managing editor of the "Scientific American," who interviewed the officials of the principal stations throughout the United States during a recent survey of the broadcast situation.

The writer compiled this wealth of material which actually represents an understandable story of broadcasting. In effect, the writer has attempted to do little more than take his reader by the hand, lead him into the heart of the broadcast situation, and there, together, comprehend the real development of this thing which has grown too rapidly for casual, and at the same time, accurate observation.

stations, with youthful vigor and plastic imaginations, added, modified and adapted innovations to enhance the presentation of their features.

Then followed an appreciable slump in the volume of correspondence as well as a marked change in the character of applause. Letters seldom suggest, today, but invariably criticize or commend.

One feature elicits response from a purely cultured class. Another brings forth a hearty response from people of education and breeding who apparently favor the less subtle renditions, but still hold themselves somewhat aloof from strictly popular features. And always, programs of jazz numbers arouse applause from the great mass that includes the several groups ranging from indifferent patrons of the muses down to illiterates.

Such letters can be classified according to the letterhead, quality of the stationery, the composition, or even the grammar of the writers. Extreme care is exercised in discounting the natural tendency of some classes to write prolifically. That precaution is necessary to accurately gauge the representation of the class to which the writers belong.

THE STUFF PROGRAMS ARE MADE OF

Programs are never settled. Even those features that have long since become a definite routine are subject to constant modifications.

Directors of programs have generally accepted the fast rule of religious services on Sunday with any departure restricted to the postive canons of dignity. But even so, variety by way of debates, choir singing or organ recitals marks the restless demand of the public for digression from the academic and prosaic.

Bedtime stories constitute another generally accepted feature. But again, the pressure of public censorship necessitates some change in the presentation. The sandman or sandwoman of one station accompanies her stories with a ukelele. Others resort to innovations of a different sort.

Sports must encompass an increasingly greater field. The managers of broadcast stations seek new varieties of sport-interest with a practical thumb on the public's pulse. Either the quantity or character of response will serve the purpose of guiding their conduct.

Talks, lectures and debates must furnish ever new material and the broadcast manager must gauge accurately the interest aroused. A stamp collector wants to broadcast a talk on the collection, assorting, testing and mounting of stamps: a new feature, but worthy of trial. Forthcoming letters determine the fate of further talks on the same subject or other talks of a similar nature. Travel lectures are tried, proved successful and accepted by all stations. Dancing instructions, moving picture reviews and a conglomerate mass of unique stunts are all tried and judged, providing that they are not propaganda for questionable societies, or subjects that have met with public disfavor through other channels of publicity, or do not injure the jealously guarded reputation of the station itself.

A speech delivered by an important figure in public life is sought at a tremendous expense to the broadcast stations involved.

Women's interest programs are arranged with organizations in close touch with feminine movements and are scheduled for hours most convenient to women with household duties. From four to five-thirty o'clock has been set aside, in several large stations, as the most propitious time for broadcasting those topics.

Because theatrical productions are arranged to be seen, program directors have focused their attention on radio plays that can be written and cast for an audience that can only hear the lines spoken. Radio personalities are developed as an end to supplementing the so-called stage personalities.

Music in any phase is certain of approval. Philharmonic concerts and classics never receive the volume of applause accorded to popular and jazz numbers, but the enthusiasm rings with the same genuine approbation in either case. Most of the larger stations employ music critics who pass judgment on requests for time on the air, and also accompany soloists. Whistlers, violinists, pianists and singers may apply for appearance on future programs, the only requisites being that they surpass a fixed standard and acquiesce to any time best suited to the equal distribution of such numbers. Solos, duets, quartets, glee clubs, club orchestras and all other amateur or semi-professional performances are likewise tested and distributed evenly throughout the programs.

Professional numbers, whether classic or jazz, are usually solicited by the station at considerable expense.

Martin P. Rice, director of broadcasting for General Electric Co.

David Sarnoff, vice president and general manager of the Radio Corporation of America

H. P. Davis, vice president of the Westinghouse Electric and Manufacturing Co.

How to Get the Public What It Wants

Determining what the public wants is one thing; next comes the question of how to get it. Program managers have confessed to some difficulties here.

The American Society of Composers, Authors and Publishers, a very powerful organization maintained by its members for the mutual protection of copyrights, has forbidden the use of any and all copyright music in broadcasting unless the station doing so pays to the League a royalty exceeding what the broadcasters believe to be right. The broadcast stations have revolted en masse. The station managers claim that the broadcasting of pieces increases the sales of phonograph records and sheet music for such numbers, and that this has been proven by an elaborate system of checking music dealers' stocks before and immediately after the broadcast program. Broadcast managers, therefore, logically conclude that sales commissions are due them if the controversy warrants an issue. In the meantime, music not copyrighted has been discovered that is equally good and as readily popularized.

Radio has undeniably injured the sale of phonographs. In fact, the phonograph industry faces a collapse unless the executives can resort to a combination unit employing radio or discover a better alternative. So the phonograph industry has opposed the appearance of its artists before the microphone. One manufacturer has conceded the reciprocal benefit of broadcasting to the extent of allowing some of his artists to perform for the radio audience.

Few of the theater managers who have produced plays that were adaptable to radio transmission have admitted the increased box-office sales directly attributable to broadcasting selections from their productions. But program directors have been able to convert enough producers to satisfy the radio public for the time being.

Unknown artists will always be procurable for very little consideration be-

W. E. Harkness, assistant vice president of the American Telephone & Telegraph Co., in charge of broadcasting

cause of their need of publicity. But the successful artists who command a following will surely demand and probably get satisfactory remuneration for their performances before the microphone. Likewise, popular orchestras, symphony concerts, opera, lecture hall programs and similarly successful enterprises must be solicited on the basis of adequate financial return. All this means a heavy expense.

Another heavy toll on the finances of broadcast stations is the cost of operation. A survey of the twelve principal stations throughout the country discloses the startling figures of $25,000 up to $100,000 per each station annually, for little beyond the actual operating and maintenance costs. The payroll is seldom less than $18,000 a year for the station personnel alone. The reception rooms, studios, and control and transmitting rooms all require enormous floor space in centrally located buildings which invariably lease their available space at a premium. The erection of a first-class broadcast station requires an expenditure of approximately $150,000.

Most of the popular features such as world series, prize features such as sermons, symphony concerts, important lectures and addresses by public figures, are relayed to the broadcast stations direct from the point of delivery.

The American Telephone and Telegraph Company employ their land wires for direct connections. Frequently, they lease open wires to their contemporaries. But that form of relay entails a personnel of rather wide scope and is very costly. The two hours consumed in broadcasting President Coolidge's address to Congress required 31 hours of testing and the tie-up of two lines throughout at a cost of nearly $20,000.

The relay tubes along the line require expert supervision and an emergency line must be held open against serious mishaps. A single telephone or telegraph line is used for the regular transmission of not less than eight service connections. The two lines reserved for broadcasting any one event, therefore, means an actual loss of sixteen lines which represent a huge revenue to the telephone company.

And still another cost is involved in carrying broacast features over lines that were originally intended for only voice transmission. Vocal and orchestral music both have wave vibrations that far exceed the natural voice period; this necessitates special apparatus supervised by skilled operators for successful carriage into the station.

The Westinghouse Electric and Manufacturing Company have erected a relay broadcasting station at Hastings, Nebraska, to which programs from KDKA, Pittsburgh, are broadcast on low waves and retransmitted almost simultaneously. However, they still face the direct wire costs from points to the station at Pittsburgh.

The General Electric Company have endeavored to side-step the costly telephone line connections by actually broadcasting from the point of enter-

(*Continued on page* 68)

The best in entertainment and culture

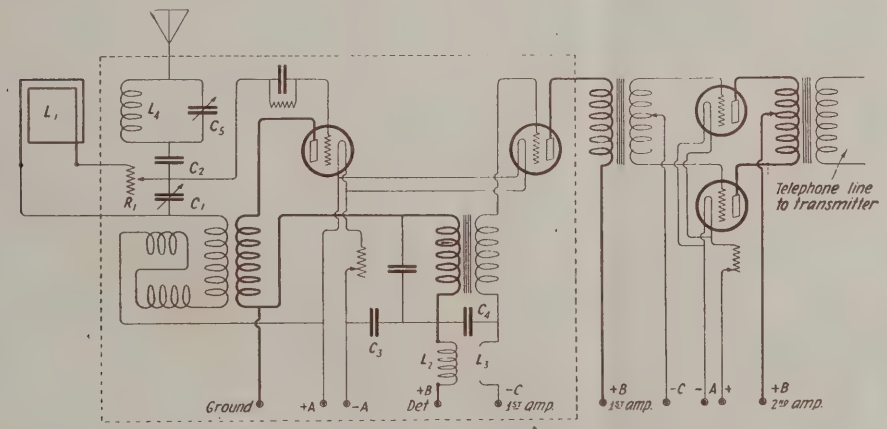
Broadcasting Makes a Giant Stretch

M. I. T. Dinner Speeches in New York Go by Radio East Over the Atlantic and West to the Pacific. This Demonstration Marks the Development of Short-Wave Broadcasting

By Jerome W. Howe

In the March issue of The Wireless Age was described the new use of short-wave broadcasting in relaying programs from a primary station to another distant station for simultaneous retransmission. In this April number it is possible to follow up with an account of a remarkable demonstration of this feat on a far greater scale. Not only do we have here an example of the rapid advance in radio progress, but also an episode which strikes home upon the popular imagination and compels prophetic speculation as to the effect of International Broadcasting. Also in the March issue of The Wireless Age attention was called to the notable accomplishment of the Telephone Company in combining wire and radio transmission in such a manner as to bring in to radio receivers all over the country a conversation carried on between persons in such widely separated points as New York, San Francisco and Cuba. On this page is recorded a still more interesting chapter of radio progress.

"NEW York Radios London and Frisco" was the style of leader by which millions of newspapers apprised their readers of a significant forward step in broadcasting. At the dinner of the Massachusetts Institute of Technology held recently in the Waldorf-Astoria hotel in New York City, the speeches of Major General J. G. Harbord, President of the Radio Corporation of America, Dr. S. W. Stratton, President of the Massachusetts Institute of Technology, Calvert Townley, Assistant to the President of the Westinghouse Electric and Manufacturing Company, Frank A. Vanderlip and David Sarnoff, Vice President of the Radio Corporation of America, as well as several musical numbers, were transmitted from the microphones in the ball-room to WJZ, from WJZ to WGY in Schenectady, thence to KDKA in East Pittsburgh whence they were retransmitted on short-wave so that they could be picked up thousands of miles away in Hastings, Nebraska and in Manchester, England, to be further broadcast. It was estimated that this event was broadcast over a total area of 1,500,000 square miles.



Circuit diagram of the Westinghouse (Hastings) KFKX Receiver

General Harbord, in happy allusion to Jules Verne, the imaginative fiction writer and forerunner of much modern scientific chronicle, remarked, "It used to be a feat to traverse the globe in 90 days, but what you have participated in tonight has made the distance a matter of seconds."

The stations operating in this demonstration were WJZ in New York, WGY in Schenectady, KDKA in East Pittsburgh, KFKX in Hastings, Nebraska, KGO in San Francisco and the stations of the British Broadcasting Company located in Great Britain.

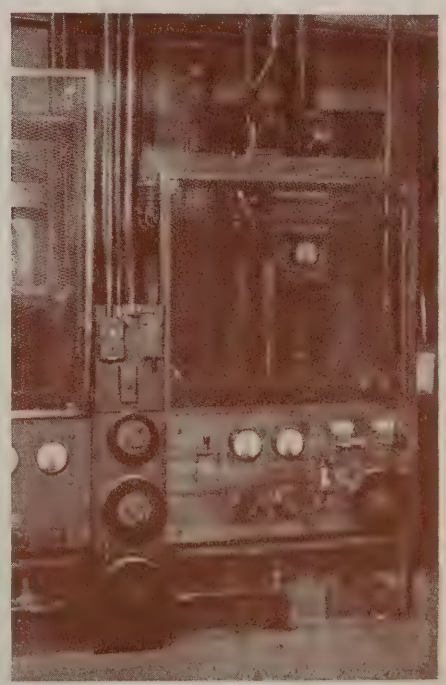
It has been inpracticable to broadcast successfully over extremely long distance by means of the usual frequencies. But about two years ago efforts were made to transmit over a considerable distance on a high frequency carrier wave for the purpose of retransmission at ordinary frequencies. It was found that fading, which affects transmission at the customary broadcasting frequencies, is reduced at high frequencies to a negligible degree. Moreover, day-time transmission by this means was proved to be almost as satisfactory as by night, a marked advantage. Also, high frequency transmission was found to be less affected by static interference.

Preliminary tests were commenced in September, 1922, between East Pittsburgh and Cleveland, Ohio, and these were quite satisfactory and promised ultimate commercial success of this application of radio. Later it was decided to try to reach out over a still greater distance and the engineers of the Westinghouse Electric Company made investigations to discover the maximum distance from KDKA at which might be located a relay station whence the signals could be rebroadcast as far as the Pacific Coast. Thus KFKX was established in Hastings, Nebraska, and the installation of this unique station, almost a thousand miles from Pittsburgh and 1,200 miles from Los Angeles, was pushed forward.

On November 22, 1923, this station gave its first program, partly originating at the studio at Hastings and partly relayed from East Pittsburgh. It was received on loud speakers in Washington, New York City, and Salt Lake City.

When a program from East Pittsburgh is to be repeated at Hastings, KDKA transmits on its regular frequency of 920 kc. (326 meters) and at the same time sends out the program on a carrier wave frequency of 3200 kc. (94 meters). It is this carrier wave

(*Continued on page* 47)



The Westinghouse 100 meter high frequency transmitting apparatus which is making the game of radio broadcasting an international sport. This Westinghouse set sends out KDKA's signals strong enough for English stations to rebroadcast

This interesting picture might well be entitled

RADIO PINNACLES

The group shown here includes the leaders of radio design, (from left to right) Dr. Alfred N. Goldsmith, B.S., Ph.D., Fellow I.R.E., Director of Research, Radio Corporation of America; Major Edwin H. Armstrong, radio inventor and designer; Professor Michael I. Pupin, Ph.D., Sc.D., LL.D Professor of Electro-Mechanics, Columbia University and Professor John H. Morecroft, E.E., President of the Institute of Radio Engineers. In the foreground are to be seen the Armstrong super-heterodyne (second harmonic) and the new Radiola Super-VIII, premier of radio receivers

The Super-Heterodyne

Major Armstrong, Its Inventor, Traces Development and Explains Principle—Full Report of Major Armstrong's Address Before the Institute of Radio Engineers Written Expressly for The Wireless Age

By Abraham Ringel
Member Institute of Radio Engineers

ON the evening of March 5th, in the Auditorium of the Engineering Societies Building in New York City, Major Edwin H. Armstrong presented a paper entitled: "The Super-Heterodyne, Its Origin, Development, and Some Recent Improvements," before a meeting of the Institute of Radio Engineers. The Auditorium was barely sufficient to hold the enthusiastic throng of radio engineers and their guests. On the platform, in addition to Major Armstrong and Professor Morecroft, President of the Institute, who presided, were Professors Pupin and Goldsmith, names to conjure with in radio. In the audience was practically every important engineer in the country. The gathering was also considerably augmented by the presence of many radio amateurs from all over the country, who were simultaneously attending the Second District Amateur Radio Convention at the Hotel Pennsylvania.

Professor Morecroft opened the meeting with a few brief remarks and then introduced Professor Pupin, who has been Major Armstrong's mentor and counsellor in all his work. Professor Pupin dwelt on the fact that it was now up to the professor to seek knowledge from his former pupils, and enumerated them, all prominent in the radio fraternity: Armstrong, Morecroft, Goldsmith, Vreeland and many others. It was indeed a proud moment for the dean of American electrical engineers when he introduced Edwin H. Armstrong, one of the most outstanding of his flock of students.

Major Armstrong, with his usual modesty of manner, disclaimed any unusual genius in his inventions, declaring that he believed he had been so fortunately placed by Divine Providence as to be just a little ahead of somebody else in making these discoveries. He then traced the gradual development of the Super-Heterodyne from the first crude model built while in the A. E. F. in France, with its multitudinous controls and at least nine or ten tubes to the present Radiola Super VIII, which is the last word in modern broadcast receivers.

Most of the wireless communication of the Signal Corps in the days of the Great War was on very short wave lengths. There was urgent need, therefore, for a radio frequency amplifier which would work efficiently for these frequencies. After exhaustive experiment with all the vacuum tubes then available, it was soon evident that, because of their high grid to plate capacity, their high filament to grid, and filament to plate capacities, not much amplification could be obtained for even moderately high frequencies such as 500,000 cycles (equivalent to a wave length of 600 meters). These capacities were of the order of 8 micro-microfarads and in general tended to act as short circuiting paths for currents of extremely high frequencies—in effect, short circuited the radio frequency amplifying transformers. The action of these capacities may be demonstrated by the reader to his own satisfaction at audio frequencies in the following manner: Connect a fairly large condenser, say .01 microfarad or more, across the secondary winding of an audio frequency transformer; the resulting volume of sound obtained from the amplifier will be very greatly reduced. The phenomenon is explained by the fact that the voltage in the windings, instead of passing to the grid of the amplifying tube, is short circuited by the large condenser.

Since it is impossible to greatly reduce these tube capacities, which are so harmful to radio frequency amplification (and which are also likely to set up oscillations in the amplifier), the problem resolves itself into working at some frequency at which these capacities will not act as short circuits. At a frequency of 1,000,00 cycles (300 meters wave length) a capacity of 8

micro-microfarads is equivalent to approximately 100,000 ohms reactance; at a frequency of 50,000 cycles (6,000 meters wave length) this capacity would give a reactance of about 2,000,000 ohms—which is very high. It is then quite apparent that an amplifier for 50,000 cycle frequency will not be affected by this capacity. This is borne out by actual practice. Amplifiers for such frequencies are quite efficient and stable—in fact they are as simple and easy to control as ordinary audio frequency amplifiers.

Applying the Heterodyne Principle

Major Armstrong realized this. The problem of converting the very high radio frequency to some lower frequency was relatively simple. It consisted merely of applying another frequency at the receiver, which was slightly different from the received signal and detecting it. After the detector will be obtained a beat note, whose frequency is exactly equal to the difference in frequency between that of the incoming signal and the local oscillator. By varying the frequency of the local oscillator, this beat (or heterodyne) note may thus be varied at will—and then amplified in a suitable intermediate frequency amplifier. After it is amplified here, it is detected once more, which restores the original low frequency sound—and amplified at audio frequencies. [The beat or heterodyne phenomenon is only too familiar to present day radio fans—it is only too evident when some neighbor with a regenerative receiver has his set oscillating. The "birdies" that you hear is nothing but the beat note, produced by the broadcast station and oscillations from your neighbor's receivers. Whenever he changes his tuning slightly, you hear the note change in pitch—since he is changing the frequency of his oscillations.]

Whenever beats are produced, there is quite a deal of amplification obtained. The beat note may be several times as loud as the signal which is obtained with ordinary detection. In case the beat note is set at some frequency which is too high to be heard, say 50,000, the above may be stated in somewhat different wording: the voltage produced after the detector by this 50,000-cycle beat note may be many times greater than the voltage produced by the incoming signal alone after being detected. So that amplification results merely from heterodyning the incoming radio frequency. After detection the 50,000-cycle beat note is picked out and amplified in a suitable amplifier. This amplifier may be made of as many stages as is desired. Here lies the main advantage of the super-heterodyne. It is much easier to amplify at these intermediate frequencies, than at either radio frequencies or audio frequencies; three, four, five and even six stages of amplification have been employed successfully. Voltage amplifications of 10,000 times can readily be secured at intermediate frequencies, as compared with 400 times for the average audio frequency amplifier. This amplification can be made to give a uniform response over a sufficiently broad band of frequencies to give excellent quality of music or speech (something which cannot be said for the average audio frequency transformer-coupled amplifier).

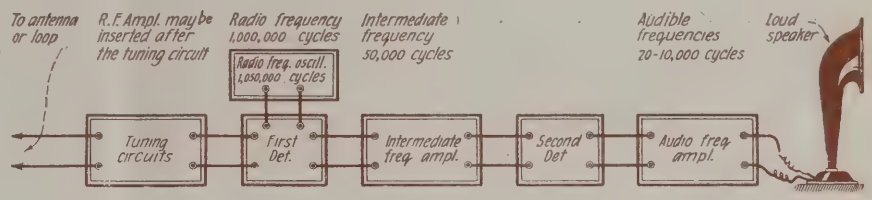


Figure 1—Principal elements in the Super-Heterodyne Receiver showing the tuning unit, first detector, intermediate frequency amplifier, second detector and finally the audio frequency amplifier.

Wonderful Results From Super-Heterodyne

After suitably amplifying this intermediate frequency, a second detector is required for obtaining the original sound. An audio frequency amplifier may be added to this. The general principles involved are illustrated schematically in figure 1. The super-heterodyne receiver is far superior to any other type of radio receiver in every respect. Its sensitivity is unequaled, for we have here not only actual amplification at an intermediate frequency, but also amplification due to the heterodyne or beat phenomenon, as explained above. Its simplicity of operation is unrivaled. Only two controls are required, neither of which is dependent on the other; one controls the frequency of the local oscillator, the other tunes the loop, which is all that is necessary for reception. It cannot be approached in selectivity. In order to emphasize these points, Major Armstrong gave a few specific examples of actual reception of station 2LO in London by an old lady in Massachusetts who had had no previous experience with radio receivers whatever—and of reception at the same time of Los Angeles, with himself at the tuning controls. Near-by locals were broadcasting at the time too. Later Dr. Alfred M. Goldsmith, in a New York apartment, had no difficulty in receiving KGO, of Oakland, California, while four powerful local stations, all well within a radius of 5 miles, were operating—and one of them was only about a meter off in wave length from KGO.

The super-heterodyne as originally build by Major Armstrong, with the capable assistance of Sergeants Houck and Lewis, was not exactly practicable. It used nine storage battery tubes—and required at least a 200 or 300 ampere-hour storage battery. The wire required to safely carry the filament current was as thick as a man's thumb. Several similar sets were built later in the United States on his return here. One of these, it is rumored, was built for Mr. John D. Rockefeller, the oil magnate; this is quite probable, as Major Armstrong pointed at one containing nine tubes which he had built

The original super-heterodyne set constructed in France during the war

about two years ago, with the remark:

"The trouble with these sets was, that it required a millionaire to buy and operate them. The average man's income was not enough to support a super-heterodyne."

Making the Super-Heterodyne Practicable

With the advent of dry battery tubes and storage battery tubes using low filament current, the problem of bringing the super-heterodyne down within means of the average man was somewhat simplified. But it was too much to expect dry cells to supply nine tubes with filament current. Besides, the construction was still too costly. There was undoubtedly need for having some of the tubes do double duty. The most practicable step was to combine the radio frequency oscillator with the first detector, i. e., employ the self-heterodyne effect. The trouble with this, however, was that on adjusting the frequency of the oscillating circuit portion, we are likely to detune the receiving circuit, and vice versa, because the two frequencies are so close. Such a system is all right for receiving telegraph signals, where the beat may be made a fairly high audible note; but in receiving telephony and music, we must make this beat frequency above audibility—and keep it there. Probably the most suitable region is in the neighborhood of 50,000 cycles per second. In the super-heterodyne receiver, if the self-heterodyne were adjusted to give a beat note of 50,000 cycles, the receiving circuit would be detuned to so great an extent from the frequency of the station it is desired to receive, that the results would be worthless. Besides, any minute change in the adjustment of one would react on the other.

After three years of experimentation in an effort to discover a means of combining the first detector and oscillator, a solution was at last found. A great share of credit for this discovery belongs to Mr. Harry Houck, who has been Armstrong's able assistant all these years. It is well known to all who have worked with radio, or for that matter, audio frequency oscillators, that if the circuits are adjusted so as to secure a given frequency, we not only obtain the frequency, but also a whole series of others, which are exact multiples of it. If, for example, the oscillator is tuned to 275,000 cycles per second, we will in addition get the following frequencies: 550,000 cycles, 825,000 cycles, 1,100,000 cycles, etc., etc., which are called second, third, fourth, etc., harmonics, respectively; these harmonics correspond to two, three and four times the fundamental frequency of 275,000 cycles. This production of harmonics is due to certain assymetrical characteristics of the vacuum tube and is not at all difficult to understand.

It is precisely similar to the production of overtones in musical instruments—where, when a certain note is sounded, we have present, not only the fundamental tone, but also a whole series of harmonics or overtones, which give the instrument in question its peculiar characteristics by which we recognize it. At any rate, in the super-heterodyne receiver, in combining the detector and oscillator, we have the oscillator work at some frequency below that which we desire to receive and select the second harmonic to produce the beat note. Thus, if the loop in figure 2 is tuned to say 600,000 cycles (500 meters), the oscillating circuit is adjusted to 275,000 cycles. The second harmonic of the oscillator is 550,000 cycles, which on heterodyning with the received 600,000 cycles, will give a beat note in the detector of 50,000 cycles. The local oscillator may also be tuned to 325,000 cycles, the second harmonic of which is 650,000 cycles—and the resulting beat note is also 50,000 cycles. Thus we will obtain results at two different tuning points of the oscillator in the super-heterodyne receiver. The frequency of the oscillator is so far from that of the incoming frequency, that there is no noticeable change in the tuning of one, when the other is adjusted. This is but one of the steps in the gradual reduction of the nine-tube outfit.

The next step in compressing the set to reasonable proportions was in the reflexing of the radio frequency amplifier with the intermediate frequency amplifier. The method involved here is illustrated in figure 3. The incoming oscillations are picked up on a small loop, which may be so small that it is readily concealed within the box containing the receiver. These are applied to the grid of the first tube through a condenser of .0001 microfarad capacity, which does not oppose the flow of currents of high frequency. These oscillations are amplified by the tube and then applied to the grid of the detector and oscillator tube (the second tube) by means of an ordinary radio frequency transformer. Note that no grid condenser or grid leak is required here, since we are detecting a frequency which is extremely high, and must rely on the curvature of the grid current and plate current curves in order to produce rectification, rather than on the action of the discharge of a grid condenser through a very high resistance.

The second tube also functions as an oscillator, which is tuned to a little less (or a little more) than half the frequency of the incoming signals. The beat note which results between the second harmonic of the locally generated oscillations and the received oscillations is obtained in the process of detection. This beat note, which is in the neighborhood of 50,000 cycles, is passed through the primary winding of an intermediate frequency amplifying transformer, the secondary of which is in the grid circuit of the first tube, which is also the radio frequency amplifier. A condenser of .0001 mfd. capacity, or even less, is connected in the grid circuit as shown, so that the secondary winding will not be short circuited by the loop circuit. In series

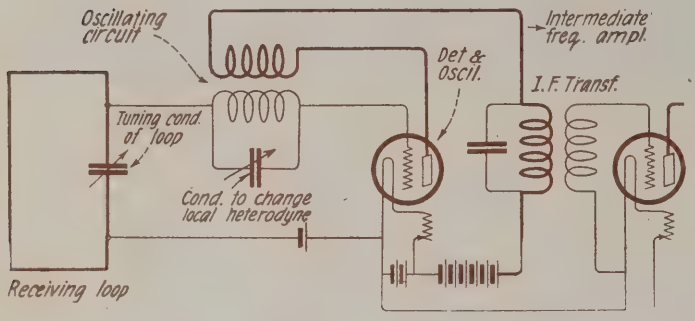


Figure 2—Application of principle of self-heterodyne to super-heterodyne

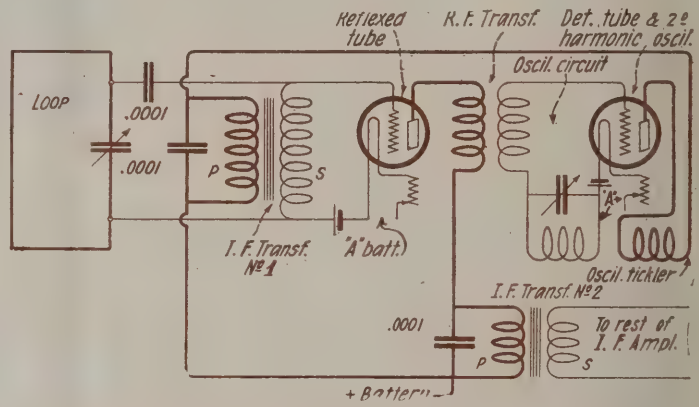


Figure 3—Principle involved in reflexing radio frequency and intermediate frequency amplifier and in using detector as second harmonic oscillator

with the radio frequency transformer in the plate circuit is connected another I. F. (abbreviation for "Intermediate Frequency") transformer, the secondary of which leads to the rest of the I. F. amplifier, which is made in the usual manner and has been described several times in past issues of The Wireless Age. The .0001 microfarad condensers shunting the primary windings of the I. F. transformers are inserted in order to allow the comparatively high radio frequencies to bypass the high inductance windings of the I. F. transformers. No filament or B batteries are indicated in the diagram—but these are connected in the usual manner.

With such combinations as these, Major Armstrong was able to reduce the original super-heterodyne to six dry cell tubes—and obtain even better results than with the nine storage battery tubes used previously. He then pointed out a number of such receivers, built within the past year, of surprisingly small dimensions. A box, about 6 inches by 8 inches by 20 inches, using six UV-199 Radiotrons was complete in every respect; it contained a loop, A-batteries, B-batteries, C-batteries, to say nothing of the super-heterodyne equipment itself, such as tuning condensers, transformers, oscillator coils, etc. It was with such equipment that that old lady received stations 3,000 miles distant!

This did not mark the end of the development. It was only the beginning! Mr. David Sarnoff, Vice-President and General Manager of the Radio Corporation, visualized its importance and immediately concentrated the forces of the Research Laboratories of the Radio Corporation, General Electric Co. and Westinghouse Co. on continual day and night work for almost a year. And the result was the finest job in radio engineering that has ever been done. Major Armstrong pointed with no little pride to a number of beautiful cabinets, which housed the new line of super-heterodyne receivers, now being marketed by the Radio Corporation of America and embodying his new discoveries described above.

In regard to selectivity, sensitivity and ease of tuning, they are without peer; local stations do not interfere at all with reception of far distant ones; only two controls are required for tuning, one for the loop and the other for the "second-harmonic" oscillator, the principle of which is illustrated in figure 3. The intermediate frequency amplifier is adjusted at the factory and sealed up, so that the set is not only simple, in its controls, but absolutely fool-proof. The only limit apparently to its sensitivity in receiving distance is *static*. Major Armstrong stated that the average inexperienced broadcast listener can easily receive from stations 3,000 miles away, any time atmospheric conditions are right, when using the super-heterodyne.

With a few brief words, promising new developments for the future, Major Armstrong relinquished the floor. Professor Pupin, in the discussion, took occasion to compliment the speaker for his manliness in giving credit, where due, to his associates and then pointed out that we had already outstripped European nations in scientific development because of our diligent application to research work, both in the universities and in our large industries. In the case of radio, there is no doubt of it at all. At the close of the meeting, little groups of the members of the Institute gathered round the various receivers on display and listened to broadcasting from stations more than 1,000 miles distant, while WJZ, only a quarter of a mile away, was going full blast—and came away convinced of the undoubted superiority of the new super-heterodyne over any other receiver that has hitherto been produced.

More About Inductance Coils

Editor, Wireless Age,

Dear Sir:

I read with interest Mr. Miller's article on "How to Design Inductance Coils," in the February issue of The Wireless Age.

I would like to suggest the following method as being more direct in the calculation of single-layer coils from Professor Hazeltine's formula:

$$L = \frac{0.0002\ N^2\ A^2}{3A+9B+10C}$$

Data given:
L = 0.08 milli-henries.
A = 2 inches; 10C is negligible.
Size of wire, No. 22 D. S. C.

Substituting:

$$0.08 = \frac{0.0002 \times 2^2 \times N^2}{(3x2)+9B}$$

The total number of turns, N, divided by the number of turns per inch is equal to the axial length, B. The number of turns per inch of No. 22 D.S.C. wire is 32 (see table II, page 56).

Then $B = N/32$

Substituting in above:

$$0.08 = \frac{0.0002 \times 2^2 \times N^2}{(3 \times 2)+\frac{9N}{32}}$$

Simplifying: $N^2 - 28N - 600 = 0$.

Solving the above quadratic:

$N = 43$ turns.

Very truly yours,

Manchester, N. H. A. H. Castor.

Latest Radio Developments

WHEN asked if the average broadcast listener could build the set, Major Armstrong said that the second harmonic super-heterodyne is a piece of apparatus which can be built only by an experienced radio engineer and that the exact dimensions of each wire and part must be known.

He said: "Radio sets are likely to become more complicated year by year and to give a person a copy of the super-heterodyne circuit and detailed instructions relative to construction would be like giving the average mechanic a complete set of blueprints of an automobile. Efficient and complex radio sets of the future will not be home-made any more than the automobile. It will be less expensive and results will be far more satisfactory if the set is purchased complete. I should not advise any one to attempt to build a home-made super-heterodyne operating on the second harmonic principle because I know the results would be extremely disappointing."

Dr. Alfred N. Goldsmith, head of the RCA Research Laboratory, said: "The set cannot be built by the average radio follower. It consists of a heavy casting called a catacomb box in which shelves are arranged for mounting the apparatus. All of the parts are mounted and then the catacomb is filled with wax, making the set practically a solid block. The instruments are so designed that they will not function the same in air as they will in the wax block. This is a new practice in construction of radio sets. If an experimenter took one of the sets apart and attempted to build a duplicate I am afraid he would experience great difficulty. A hook-up or blueprint of the second harmonic super-heterodyne would be about as useful in building the set as a map of Asia."

The slightest deviation from the exact wiring, such as moving a wire a fraction of an inch out of its proper position or making a wire a trifle too long, will change the capacity effect and make the entire circuit inoperative. A slight variation in wiring would cause distortion which, in a single tube set would be unnoticeable, but in a six-tube super-heterodyne outfit this distortion is highly amplified and howls dominate the incoming music.

Dr. Goldsmith said that the ordinary type super-heterodyne receiver, as built experimentally by some radio enthusiasts, using from eight to ten tubes, was difficult to operate and radiated energy continuously, although the operator was not aware that his set was squealing and interfering with his neighbor. With the regenerative circuit the operator can tell when his set is disturbing near-by receiving sets, but in the case of the old type super-heterodyne only the neighbor can tell that the set is howling.

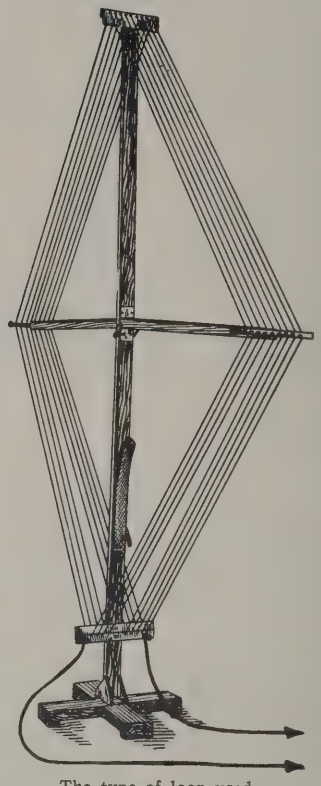
The new set has a new principle called the "regenoflex," and by the use of a special muffler tube circuit radiation from the set is eliminated.—*The New York Times, Sunday, March* 16, 1924.

The Wireless Age Reflex Loop Receiver

A Four Tube Set With Crystal Detector

3 Stages of Radio Frequency
2 Stages of Audio Frequency

Designed by R. A. Bradley
with the collaboration of Samuel C. Miller
Member of the Institute of Radio Engineers



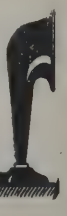
The type of loop used

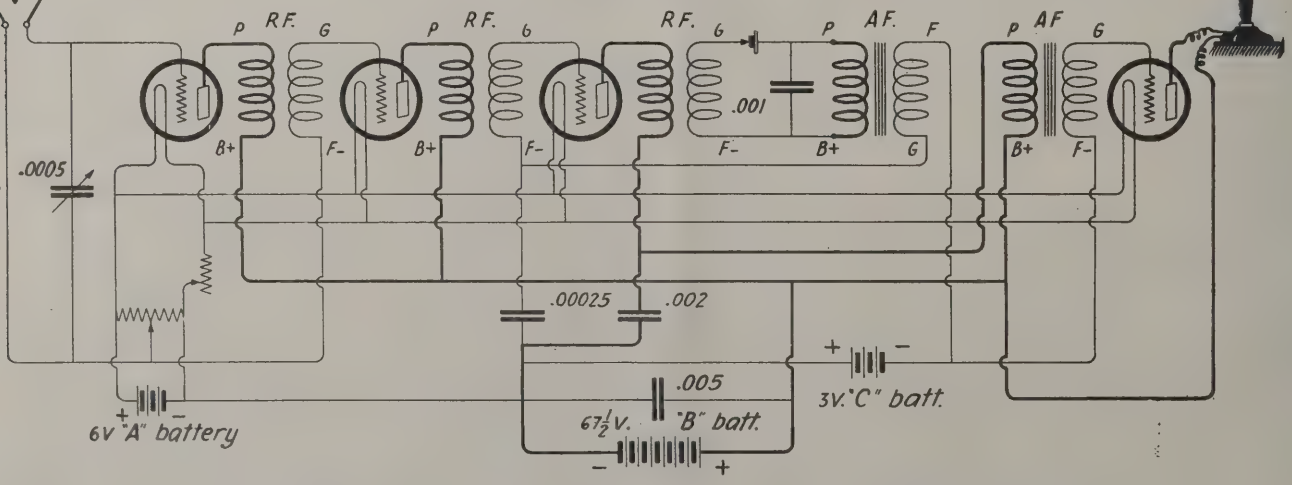
NOTE—Certain patent owners permit amateurs to make up their own radio devices for their own use and not for sale. Relying on this policy this article gives suggestions to aid amateurs in their experimentation, but no license under patents is to be inferred from the publication of these suggestions. The license rights exist only through the generosity of the patent owners and if any owner should object, the amateur should refrain from using the particular invention involved.

WITH the steady increase in the number of broadcasting stations there has naturally come an increased demand for a receiver which can successfully separate two or more powerful stations closely approximating the same wavelength. Then, too, the broadcast enthusiasts, located in very congested districts such as New York, Chicago, Philadelphia and other large cities are in many cases prevented from erecting an aerial on the roof, and must resort to some other collector of energy. The loop receiver has fulfilled these two issues admirably, but heretofore has required so many tubes that the cost was prohibitive. It is necessary to use at least three stages of radio frequency amplification before the detector, in order to amplify the small amount of energy that a loop is capable of collecting to such an extent that the detector will respond and carry to the head phones an audible signal. Then it is necessary to build up this signal by means of at least two stages of audio frequency amplification in order to have sufficient volume to operate a loud speaker. This, in all, means that we must have six tubes. Too much, too much!

Now, if we use a crystal detector in place of a vacuum tube we have saved one tube and improved the tone quality of our reception! A crystal rectifies with little or no distortion while such cannot be said of the average tube working at an unfavorable point on its characteristic curve. Now if we reflex the first stage of audio back into the third radio frequency tube we save one more five-dollar bill, and in no way sacrifice our tone quality, sensitivity, or ease of control.

With these ideas in mind we have developed this month THE WIRELESS AGE Reflex Loop Receiver which embodies a loop tuned by means of a variable condenser with an excellent vernier attachment, three stages of transformer-





The diagram layout. Note the manner in which the small fixed condensers are connected in the circuit

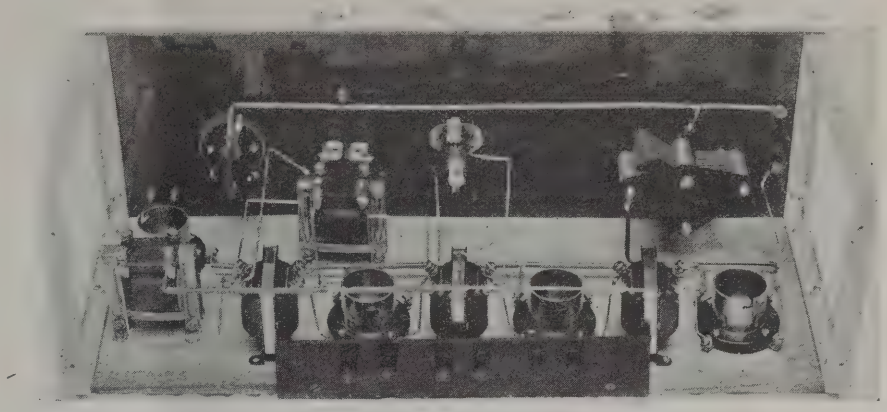
A Thoroughly Tested, Practical and Proved Receiver

coupled radio-frequency amplification, a crystal detector and two stages of a.f. using four UV201-A's!

The Panel Lay-Out

The Radion panels were used because they are easy to work and present a very pleasing appearance. First of all locate the hole for the condenser shaft four inches from the left end and center it up and down on the panel. Next, mark out the holes for the rheostat in the exact center of the panel, then the potentiometer four inches from the right end, using in each case the templates furnished with each instrument by the manufacturer. The two holes for the crystal detector are now located two inches apart between the rheostat and potentiometer and two inches from the bottom of the panel. The Eby phone block may then be placed two inches from the right end and one and one-half inches from the base. Next drill the holes for the Quinby aluminum frames three-eighth inch from the ends of the panel so that the tops of the frames come flush with the top of the panel. This will leave a space at the bottom to fasten the baseboard.

Follow closely the photographs in mounting the rest of the instruments on the baseboard as the arrangement shown represents much experimentation in providing shortest leads and general all-around efficiency. The radio frequency transformers and tube sockets are mounted flush with the rear of the baseboard, placing them approximately 3 inches between centers. This provides for the shortest possible grid and plate leads at the same time keeping as low as possible capacities between these leads. If you attempt to hook up a radio-frequency amplifier with wires running helter-skelter you create high capacities between the grid and plate of each tube causing them to oscillate beyond the control of a potentiometer which of course is a highly undesirable feature. The first audio - frequency transformer is mounted between the third tube socket and the panel. This is the most natural arrangement since the output of this transformer goes back into this third tube for the reflexed stage. The second audio-frequency transformer is mounted flush against the rear of the baseboard at the extreme right, where its output may be conveniently fed into the last tube socket placed between the transformer and the panel.



Rear view of baseboard layout affording a good idea of the general arrangement of instruments

List of Materials

One .0005 mfd. variable condenser (Pacent). This condenser must be a good one as it is highly important that losses in your collector circuit be kept very low. One 400-ohm potentiometer (Pacent) and one Filkostat. These instruments are well made and add to the appearance of any set.

Four sockets (Paragon standard).

Three radio frequency transformers (Jefferson). Very satisfactory results were obtained with these.

Two audio frequency transformers (Jefferson). Ratio 6 to 1 and 4½ to 1.

Eight binding posts (Eby).

One Accuratune dial. This instrument is very satisfactory as its vernier adjustment is all that could be asked.

Two Quinby Aluminum Frames for seven-inch panel.

One Radion panel, 7x21x3-16 inches.

One hard rubber strip, 2x14x3-16 inches for mounting binding posts.

One .001 mfd. Dubilier fixed condenser.

One .00025 mfd. Dubilier fixed condenser.

Two .002 mfd. Dubilier fixed condensers.

Eight lengths of round bus wire. The round bus wire is much easier to handle and presents quite as good an appearance.

Four lengths of yellow cambric tubing.

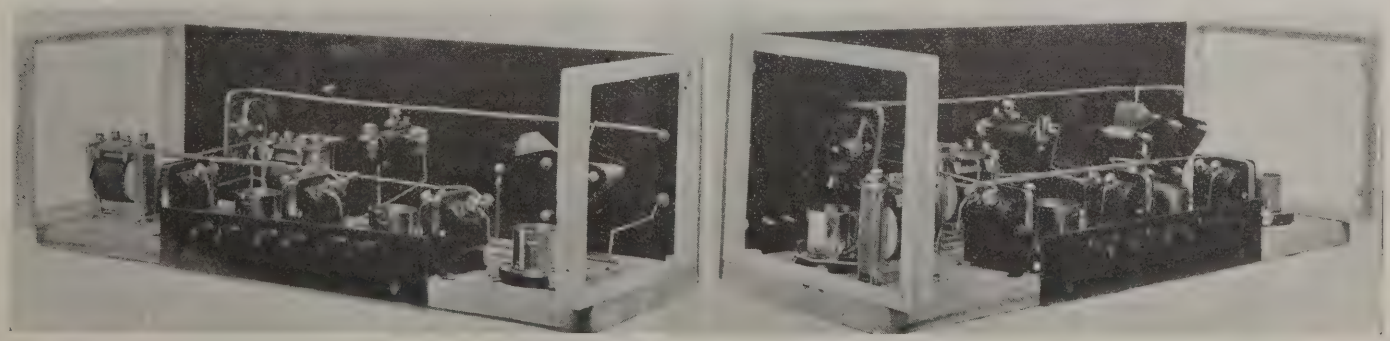
Two dozen assorted lengths wood screws for mounting instruments on baseboard.

One baseboard 7x21x¾ inches pine or soft wood.

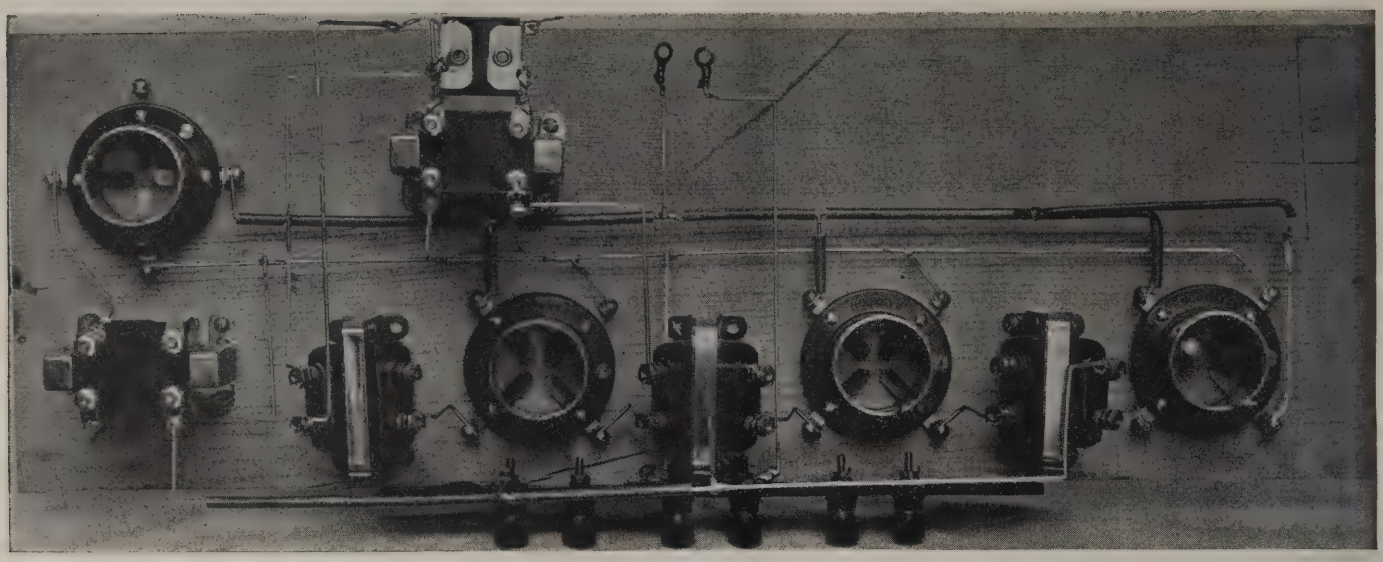
One Grewol fixed crystal detector.

The first connections to be made after placing all the instruments are the filament leads. These connections are plainly shown in one of the illustrations. Run one of these leads to the rheostat and from there to the binding post on the sub-panel in the rear of the baseboard. Connect the other lead direct to the other A battery binding post. Now before going further connect up your storage battery to these terminals and place all four tubes in their sockets and make sure that they all light properly. If this is done now it will obviate retracing your filament connections in case of an error later on. Now connect up your transformer leads. If the transformers are mounted correctly, that is, primary left, secondary right, the grid and plate leads will probably be less than two inches long which is what we have been striving for.

Be sure not to omit the small fixed condensers shown in the diagram. The



The various connections can be plainly seen in these two views. Note the short leads from transformers to tube sockets



Top view of the baseboard showing in detail the placing of each instrument in relation to the others. This arrangement proved to be the most satisfactory. The .001 mfd. fixed condenser is mounted directly upon the posts of the audio transformer

.005 mfd. fixed condenser is shunted directly across the B battery binding posts on your terminal strip and acts as a by-pass condenser around the B battery. The B battery with its long leads and inherent high resistance must have some sort of by-pass for the radio-frequency currents. The .002 fixed condenser serves the same purpose with respect to the primary of the second audio-frequency transformer. The .001 fixed condenser acts as a by-pass condenser across the primary of the first audio-frequency transformer, performing the same function as a phone condenser in an ordinary hook-up.

The loop is connected to the two binding posts on the left of the panel. Leads from these two posts go then to the variable condenser. Be sure that the potentiometer is connected to the rotor plates of the variable condenser and the grid of the first tube to the stator plates. This will practically eliminate any hand capacity effects, as there is practically no difference between the potential of your hand or body and the filament circuit.

There is a point on the plate current-grid voltage curve of every tube where that tube will amplify to its greatest extent with a minimum of distortion. That is, in order to make our amplifier work most efficiently we must use at least 67 volts on the plate of the tubes and at the same time keep the plate current low by making the grid negative with respect to the filament. In order to do this easily we have embodied in the set a "C" battery of three volts, thus preventing distortion, lowering our plate current, and lengthening the life of our B battery. The leads from the audio frequency transformer posts marked F or A, are brought to the negative C battery binding post on the terminal strip. A connection is then made from the positive C battery binding post to the negative filament lead.

Accessories

Four UV201-A tubes.
One 6-volt storage battery.
One 3-volt C battery.
Two 45-volt B batteries.
One loud speaker.
One loop antenna.

The Loop

Several types of loop antennas were used with this receiver and the one shown proved to be the most satisfactory. It is well to note that a loop receiver with a non-directional loop is well-nigh useless in highly congested districts as the selectivity of the receiver rests entirely with the loop and tuning condenser. With a directional loop you can, by swinging its planes into the direction of the station, eliminate all stations except those in a direct line with this plane. Now here is an important thing to remember: A loop antenna in order to be directional must have roughly speaking a total length of wire equal to ten times the distance from the top of the loop to ground connection. So if we are to have a directional loop we must arrange to use a total length of wire at least ten times its height from top to bottom. Such a loop can be constructed of two pieces of wood 1½x¾ inches joined together at right angles at the center, and braced securely on the ends of each piece are mounted hard rubber strips 5x1 inches slotted every half-inch to take eight turns of wire. In winding the loop you may use ordinary lamp cord or No. 16 D.C.C. copper wire. The former is more flexible and is easier to wind while the latter is more rigid and will stand more rough treatment.

Operation

The actual operation of this set is as simple as can be—as we promised you. Turn on the filament rheostat until the tubes burn at their proper brilliancy. Set the potentiometer at about the middle. Then swinging the loop, turn the variable condenser knob until a signal is tuned in. Now gradually increase the potentiometer until maximum volume is secured. If the potentiometer is turned too far the set will oscillate. The most sensitive adjustment is just before the oscillatory or "squealing" point.

Next Month We Will Give You a Non-Radiating Super-Heterodyne

I Am Broadcasting to Form Character

A Broadcaster With a Purpose:

Peggy Albion

Tune in to WRC about six of an evening and hear one of Aunt Peggy's stories. It will be worth your while

By Geoffrey Ames

When Aunt Peggy gets home after telling her stories to her radio audience she tells the same beautiful tales to her own young son Master Norwood

"WE must educate through the emotions." The accumulated earnestness of ten years and more of work as a leader in the field of child-education spoke through eye and voice and gesture. Mrs. Marietta Stockard Albion, premier bed-time story-teller, is such not by any trick of suddenly acquired inspiration or cleverness, not because of any urge to fill a newspaper column each day. She tells the finest bed-time stories in the finest manner because this has been her study for years. She is an experienced teacher of child-training and has been in charge of child-work in such institutions as the University of Virginia, The Wilson Normal School and George Washington University.

"Story-telling has been my laboratory for kindergarten training. And my experience has taught me that it is through the story that the young developing mind is to be reached. Lessons will make anyone a dullard. The story arouses a quick interest and the interested mind grasps new ideas without effort.

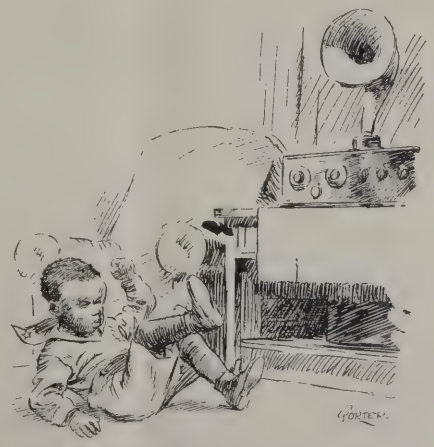
"I have seized eagerly upon radio-broadcasting as a means of extending my work. It is wonderful—this radio. Have the people in the radio industry any idea, I wonder, what a tremendous agency for good—or otherwise—they control? Think of the influences that can be brought right into the home by this wonderful means!

"I am so glad that my bed-time stories over the radio have become so popular! For my stories are doing more than merely entertain. Do you realize that it is character we are forming by these stories? Yes. By telling stories to children—the right stories—we form and mould their character."

Mrs. Albion has studied the stories of all nations. She has collected the best stories of the world into a splendid anthology which she draws upon for her message delivered each evening to the little folks from WRC. Hers is no experiment, no hit-or-miss performance. She knows that her stories are good. They are the cream of the world's story-telling through the ages.

"But are you sure that the children—the children themselves—enjoy your stories? Without the visualized personality, the attraction of facial expression and of gesture, can little children be effectively reached by radio? Can their restlessness be controlled by the voice alone?" I have heard these queries and doubts expressed with regard to the value of bed-time stories, and I repeat them.

It was an eager, enthusiastic "Peggy" Albion, as she is known to her radio audience, who replied.



"This little boy-pickanniny throws himself on the floor"

"Yes, yes and yes! You should see some of the letters I receive.

"I have one from a negro doctor. He says that when, at about the bed-time story hour, some other voice than mine comes through the loud speaker, his little boy-pickaninny throws himself on the floor in a rage, feet in the air, and kicks and howls."

Mrs. Pickett, well-known society editor of the Washington *Evening Star,* tells how her little granddaughter listens eagerly to "Aunt" Peggy's stories and how when she is interrupted and takes the phones from her ears she says "Scuse me, please, Mrs. Albion."

Naturally, since letter writing is the proclivity of the elders, some of the most interesting letters tell of the reception of the bed-time stories by older children and grown-ups.

A retired general in Virginia excuses himself from his company every evening at bed-time story hour by announcing that he has a date with Mrs. Albion.

An elderly couple whose children have all flown from the old nest and upon whom rests the weight of great loneliness, listen in together and are made less lonely by Peggy Albion.

A Christian Science practitioner writes to commend Peggy's stories and states that she uses them in her work because they are full of the message of love and strength and courage.

"On New Year's Day," remarked Mrs. Albion, "I selected that wonderful story by Tolstoi, 'Where Love is there God is also.' Before I was off the air a man phoned in to the station to ask what story it was and where he could find it."

A fan in the back country of Maryland writes to tell how the people of his community are shut off from the

(*Continued on page* 51)

Peeps Into Broadcast Stations

"Cow-Bells. That's All"

Cow Bells on the Air

THE jingle of the cow bells to millions of fans throughout the North American continent—and beyond, has come to stand for "WBAP," the broadcaster of The Fort Worth, Texas, *Star-Telegram*.

The first old-time square dance ever broadcast was introduced to Radio fans by WBAP, something over a year ago.

One of the features of this station is the droll humor of the Hired Hand, the boiler room functionary of the *Star-Telegram* who manages to leave his fires long enough to get before the microphone twice a week. Otherwise he is president of the Truth Society and has built up a membership of 150,000 throughout the country. Those eligible for membership must first tell a "truth" of sufficient proportions and swear to prevent abuse and overwork of the "truth." They are then sent a handsome, embossed certificate of membership in good standing.

Roberta Beatty, mezzo soprano, broadcast from WEAF recently

Portable Broadcast Station

WTAT is at the present time operating as a portable station which is something very unusual in the radio broadcasting line. The equipment is installed upon a Reo speed wagon and is entirely self contained, including operating board, monitoring system, battery charging and the receiving set required in broadcasting stations. This truck is moved to any desired location and the announcer's panel is installed in the building and lead covered cables carried from there to the truck. The antenna is on the roof of a neighboring building or sometimes strung up between two poles.

This station has been operating at various electrical community shows held in the suburban towns adjacent to Boston. When there happens to be no show they operate from the Edison Service Building.

Community Station of Twin City

UP in "The Land of Ten Thousand Lakes," WLAG popularly known as the Twin City Radio Central, broadcasts alternately from Minneapolis and St. Paul. It was recently adopted by merchants' associations and business concerns of Minneapolis and St. Paul who created a "community fund" to help cover program expenses and help aid this "biggest of civic assets."

WLAG operates on a subscription basis with a view to overcoming the economic problem of broadcasting.

Eleanor Poehler, who, so far as is known, is the only woman in complete charge of a radio broadcasting station in the country, is the manager of WLAG. She hires, fires and inspires the entire staff. She organized and developed her entire staff of musicians, including her orchestra which is now on tour in the South. Charles Corday, leader of the "Slowpokes" orchestra, is a song writer, who, whenever the studio feels the need of new material, lays aside his baton and composes something.

The Minneapolis studio and WLAG'S antenna are at the Oak Grove hotel overlooking the business section of the city. The St. Paul studio, just completed, is on the top floor of the St. Paul Athletic Club building. Programs from the latter are broadcast by remote control through the Minneapolis plant. This gives the Twin City Radio Central extraordinary possibilities for rebroadcasting important programs and talks from other stations, besides a flexible studio equipment for handling large organizations.

Eleanor Peohler, managing director of WLAG, one of the few women in complete charge of a broadcasting station

New Broadcasting Studio for Station "WBZ" in Boston

WBZ, located on the roof of the Hotel Brunswick, Boston, broadcasts regularly from the station, one hundred miles distant. Although broadcasts have been made by other stations at various times at distant points from the station, this is the first time in broadcasting annals that a studio is permanently located at such a distance from the station for every night, all-the-year-round broadcasts.

This broadcasting system has been jointly worked out by the *Boston Herald-Traveler*, the Westinghouse Electric & Mfg. Co., and the Brunswick Hotel. On the top of the Brunswick Hotel has been built a studio that

The "Call of the North" orchestra of the St. Paul Athletic Club which made its first bid for fame from WLAG

measures up to anything that has been done in the past for convenience and beauty. In the building that has been constructed on the roof of the hotel is the studio, thirty by forty feet in size and the ample reception room with a rest room for the ladies.

Since the radio microphone is the most sensitive thing possible for picking up sound and extraneous noises not audible to the ear might injure the quality of the broadcasting, the building was built of heavy gypsum block supported on steel girders and the inside was lined with a sound-deadening lath designed to prevent the outside sound from getting into the studio. After this was done successfully, the studio walls and ceilings were covered with a flannel draping trimmed with old rose silk.

The ceiling draping is done in Egyptian fashion with the drapes from the longer sides coming together in the center to form a shape similar to a tent. The part usually designated as the ridge pole is covered with the old rose silk. At each corner similar strips of silk hang from the ceiling for a distance of about two feet.

The studio is furnished with a Steinway Concert Grand Piano, a davenport and chairs of appropriate coloring. Exquisite piano lamps complete an artistic setting.

In the corner of the room opposite from the piano, is the operating desk upon which are mounted the control switches for the microphones in the studio and in the theatres and concert halls. There is a roll-top desk completely covered to prevent reflection of sound from the hard wood which might create distortion.

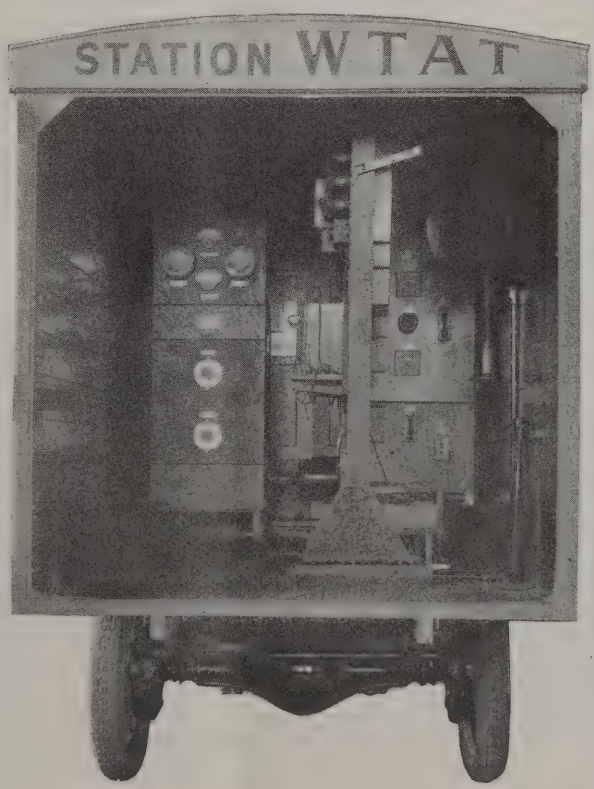
In order to make the project successful it was necessary to have constructed an entirely new line from Boston to Springfield. This line is slightly over one hundred miles in length and connects the studio at Brunswick with the Radio Station at East Springfield.

Sears-Roebuck Again

A NEW type of forensics for radio is to be developed by Sears-Roebuck Agricultural Foundation for the new broadcasting station which is being erected by the Foundation to broadcast exclusive agricultural programs.

Samuel R. Guard, Director of the Foundation said that this new type of forensics for radio, which is different from any now in use, will adapt the speeches to the medium. It will be developed specially for radio, because one cannot talk into a microphone as one would talk from a stump or a stage.

The programs broadcast by this station will be balanced agricultural programs, which will challenge the farmer's attention and hold it. Facts of real value to the farmer will be broadcast. Theatrical stars will bring the stage to the farmer's parlor, and there will be bedtime stories for the country kiddies. An interpretation of market trends and a current events feature, explaining what is going on in agriculture all over the world, will be given according to Mr. Guard. This new station, which will be the only one in the United States broadcasting exclusive agricultural programs, was completed recently.



A broadcast station that is really "up and going"

Health Talks Now Broadcast by CKY

The Manitoba Telephone System's station at Winnipeg has inaugurated a new series of short talks to be delivered at the studio on Tuesday evenings by a number of doctors representing the Manitoba Dental Association. The talks will consist of a scientific presentation of the subject of dentistry with details of mouth anatomy, ills and remedies and general care of the teeth.

The World Within a Prison Cell

Prison Walls Are No Barrier to Radio

As told by No. 186, a "Lifer," at New Hampshire State Prison

New Hampshire State Prison. The loud speaker is placed at the head of the hallway leading down between the tiers of cells. The prison set is operated for all prisoners between seven and nine o'clock

"RADIO" A VOICE FROM BEHIND THE BARS

DID you ever "do time"? No? In most all prisons the Silence Rule is in force. (Thank Heaven it is slowly being abolished here!) If you have maintained "silence" for over six years and then are given the opportunity to express a few of your ideas on paper you will appreciate how I feel about being able to tell here to the readers of The Wireless Age how Radio has brought the world to those of us whom the world has shut away.

Please, reader, bear in mind that a prisoner is not a special sort of a human being. We are no different from the majority of people. We are, most of us, just like you! But Radio means much more to us than it can ever mean to you. So I hope you will read about my efforts to enjoy Radio.

Yours truly,
Number 186.

DO you want to know just how I came to have the rather remarkable outfit I own? It's a bit extravagant for a person "doing time" and solely dependent on what little money he earns in the prison shop and by his work during his spare time in his cell.

Last August I bought the Westinghouse RC unit from one of the department stores of Boston. It was bought on the installment plan. After I purchased it I wrote to the manager, or buyer, of the book department of this same store and succeeded in selling him quite a good order of Christmas cards that had been hand-colored by me personally. I have been doing work of this kind for several years. This order helped me out considerably in meeting the monthly payments. The remainder of the cost was met ahead of time through the sale of similar cards to other people.

Last November I wrote to a corporation in New York and asked if I could obtain a discount on the antenna coupler, Radiola RT. Much to my surprise, and also delight, I received as a gift this coupler, and from another concern I received the radio frequency amplifier, Radiola AR. I had been thinking that sometime in the far distant future I might be able to save up the $80 necessary to purchase this unit. I also received four UV-201A tubes, three "B" batteries, and a "C" battery. That made it necessary for me to have a storage battery, as I had been running WD-12 tubes with dry cells. I began to count my money and soon after Christmas decided I had enough from the sale of cards to pay for a storage battery. I sent for our local radio dealer, who has been extremely kind to all of "us radio fans." He came on a Saturday afternoon, but just before he arrived I received another letter advising me that a storage battery was on its way. What luck! My own money went for two more tubes, a loading coil and voltmeter.

At Christmas time I received from a "radio friend" in Connecticut (a real friend, for he keeps me constantly supplied with all the latest radio magazines) a gift of five dollars. From another friend I received another five dollars! From an unknown friend a gift of one dollar. I also was given a "Short-Cut Radio Antenna" which I have not yet had time to try out. It has been used on the main prison set and works very well. It was really the most enjoyable Christmas that I have had for many years. Usually the Christmas season is very hard to bear. It reminds one so much of the things he is forced to miss!

For an antenna I use a piece of copper screen, thirty inches wide and six feet long. For a ground, my bed! I have received from over fifty different broadcasting stations. This number includes such stations as PWX and WOC; also WOS, WLAG, WPAH and many of the nearer stations.

I have heard Lloyd George, Woodrow Wilson and Calvin Coolidge; also Nina Wilcox Putnam and William J. Burns. I "went to" all of the Harvard football games last Fall. Some afternoons I "attended" as many as three different games in places as far apart as the Harvard Stadium and the field of the University of Pennsylvania. I enjoyed the World Series at the Yankee Stadium and at the Polo

THE COUNT OF MONTE CRISTO

EDMOND DANTES, a French sailor, was cast into prison where he was destined to rot in a cold, damp and oppressively dark dungeon. His romantic contact with the Abbé, a fellow prisoner, gave to Dantes a knowledge of the world replete in its wealth of learning and vision. When he finally managed his escape, Alexandre Dumas was pleased to send him back to France as the M. Le Comte de Monte Cristo. We have all come to know the exploits of the Count of Monte Cristo, which were possible because the sailor, Edmond Dantes, had been able to absorb the vast scope of the Abbé's learning.

The letter to The Wireless Age from prisoner number 186 would indicate an analogy between radio and the remarkable Abbé; radio can bring the world's knowledge to the prisoner of today just as the Abbé imparted it generations ago to the poor sailor boy in the dungeon of Château d'If.

Grounds. I didn't pay any outrageous sum for a ticket either! Just turned a dial and there I was! In fact I have been having a real good time and look forward to many more good times. I had almost forgotten such things existed.

But after all, the greatest thing radio has done for me has been the restoration, in part at least, of my former belief in the "goodness" of the human race! The many kindnesses that I have received have shown me that there are still certain men who really do believe in doing a "good deed" to one less fortunately situated than themselves. My faith in my fellow men has been restored and perhaps that is the greatest thing that could have been done for me.

The set maintained by the prison runs only from 7:30 to 9:00 in the evening unless there is some special program, like the Dempsey-Firpo bout. In a case of that kind the main set runs later and the lights in each cell are not turned off until the program is finished. Usually they are turned off at 9:00 P. M. The men that have sets of their own are permitted to run as late as they wish provided they do not disturb their neighbors and are able to do their share of the work the next day in the shops.

Personally I have been very much interested in radio for some time. I never had the necessary money to purchase a good set until the Westinghouse RC unit was placed on the market last Summer at $59.00. I jumped at the chance to own one of these sets and you may be assured that I have never regretted my purchase.

* * *

My set is not complete and never will be. There are several things that I am going to add to it when I have saved the necessary money. I have already ordered a crystal detector that I wish to experiment a bit with, also the loading coil that attaches to the back of the RC unit. This coil will permit me to receive the code that comes in on the longer wavelengths. Then I wish to try a "B" storage battery. And I am quite interested in the Finch relay! I shall evidently have to wait quite a while before I can afford all of these articles, but it's nice to have something to look forward to!

I shall never be satisfied no matter how good results I get!

I want to get "California" and I shall get it when I get completely "hooked-up!" After "California" I shall try for England! Then for Hawaii! And then—well, I may try to find out just what these mysterious waves are that seem to be coming from Mars! Perhaps some of Edgar Rice Burroughs' weird creations are trying to communicate with us by radio!

The programs as they are at present are very good indeed. I have enjoyed nearly everything that I have heard, including "Bed Time Stories!" I listened in on Santa Claus, who was at WGY one night, and I could very easily imagine the delight with which the youngsters heard him call them by their own names and promise to bring them the presents they had asked him for! I almost wrote to him myself!

I am rather inclined to believe that it might be an advantage if certain stations were limited to a certain kind of program. For instance, WGY some night might send out a lecture while KDKA was sending out orchestra selections and some other station was broadcasting a play or musical comedy. It would be an advantage to have the stations limited in number also. Personally I would like to hear more lectures and speeches by prominent men and women.

* * *

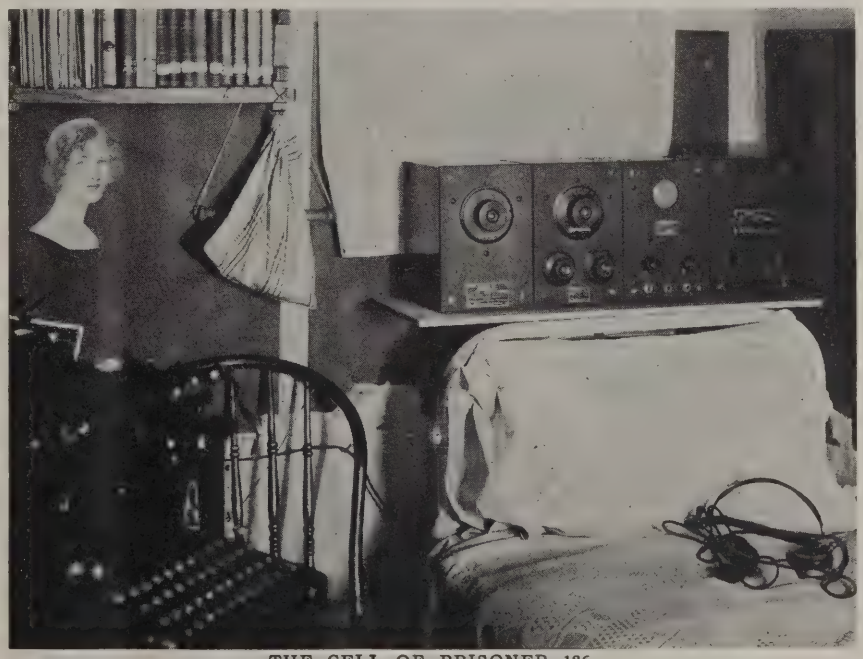
In my humble opinion, offered for what little it may be worth, radio can be of the greatest possible help to those raised in environments such as to make them enemies of society, as

well as to those who are already so-called "enemies of society."

Since I came to prison I have read every book on criminology that I could get my hands on. I have talked with nearly all of the men that have passed through here in the six years that I have been an inmate. I have come to the conclusion that nearly all crime can be traced to the conditions in the homes when these fellows were children. Many of them have been in so-called Reform Schools. The prison "term" for a Reform School is "Prison Kindergarten!" Many of the fellows ran away from home and no boy runs away from a home where he is understood. If we really wish to diminish crime we must tackle the problem at its very roots, and that means the home. Make every dwelling place a real home and crime will be cut 90 per cent.!

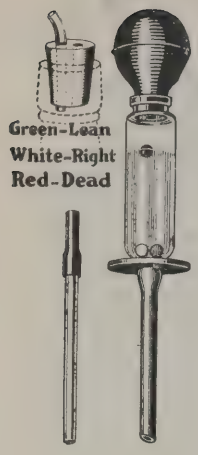
Who can at present imagine a more successful way of making a better home than by installing a radio set for the youngsters as well as for the "grown-ups"? It seems to me that as things are nowadays nearly all young people get away from their home just as much as possible. But a radio in

(*Continued on page* 51)



THE CELL OF PRISONER 186

A copper screen is stretched above the bed for an aerial. Back of the set is a map of the United States, with stations received, marked. On the left is part of his library collection



STORAGE batteries and rechargers with their connections need not be unsightly as is seen from this photograph of a bookcase in which the receiver reposes on the upper shelf and the battery equipment is stowed away in the bottom compartment.

To left is shown one type of hydrometer, the Chaslyn Ball Battery Tester, for which the legend runs:

Float all three—charge fully.

Sinks the white—charge still right.

Sinks the green—charge is lean.

Sinks the red—charge is dead.

How To Install and Maintain the Storage Battery for the Radio Receiver

Your Radio Storage Battery

By Donald Gordon Ward

Associate Member, Institute of Radio Engineers

YOUR Storage Battery is an important part of your radio set. If you handle it properly and intelligently it will be efficient. If you do not know how it should be cared for it will fail you and involve also needless expense. Mr. Ward tells you what you should know about storage batteries. Moreover, he shows how the storage battery may be properly cased along with the receiver in a handsome piece of furniture.

AS the storage battery plays such an important part at the present time in connection with the operation of the average radio receiver it seems fitting that more attention should be paid to the rules which, if observed, will insure the efficiency that should be expected.

The storage battery is a chemical generator of electricity. During the so-called "charging process" a current of electricity passes into the storage battery. Then during the "discharging process" a current of electricity is drawn from the battery.

However, in between the charging and discharging processes there is no electricity in the battery. This last statement would seem absurd on the face of it. But electricity cannot be stored up, that is, in the form of electricity. The storage battery stores up electricity in the form of electro-chemical energy. When the current of electricity flows into the battery a certain chemical action takes place which "charges" the battery.

For any chemical action there is an equal and opposite chemical reaction. The current of electricity passing into the battery causes the chemical action to take place. Then after the battery has been disconnected from its charging source and has been connected to some device, such as a radio receiver, which utilizes electricity, the reverse of the first chemical action takes place and the battery generates another or second current of electricity, which flows from the battery. But this current is not the same current that passes into the battery during the charging process.

Keep Your Battery Charged

A storage battery should be maintained in a fully charged condition whenever it is standing idle. This means that it should be placed in charge almost immediately after being used. For the man who carries his battery to the nearest charging station this becomes rather a nuisance and about the only remedy is to have a battery charger in the house, so arranged and connected that it will only be necessary to throw a switch in order to place the battery on charge and then reverse the switch in order to use the battery with the radio receiver.

The photograph figure 1, shows the appearance of such a set-up in combination with the receiver. The top section of the bookcase holds the receiver, the middle section is filled with books and the lowest section contains the storage battery, of 80 ampere-hour capacity, the rectifier, and "B" batteries. When the doors of the bookcase are closed there is no visible indication of the presence of a radio receiver as the loud speaker is in a cabinet type phonograph and all visible connections are made with white silk lamp cord which blends in with the finish of the room and therefore is practically invisible.

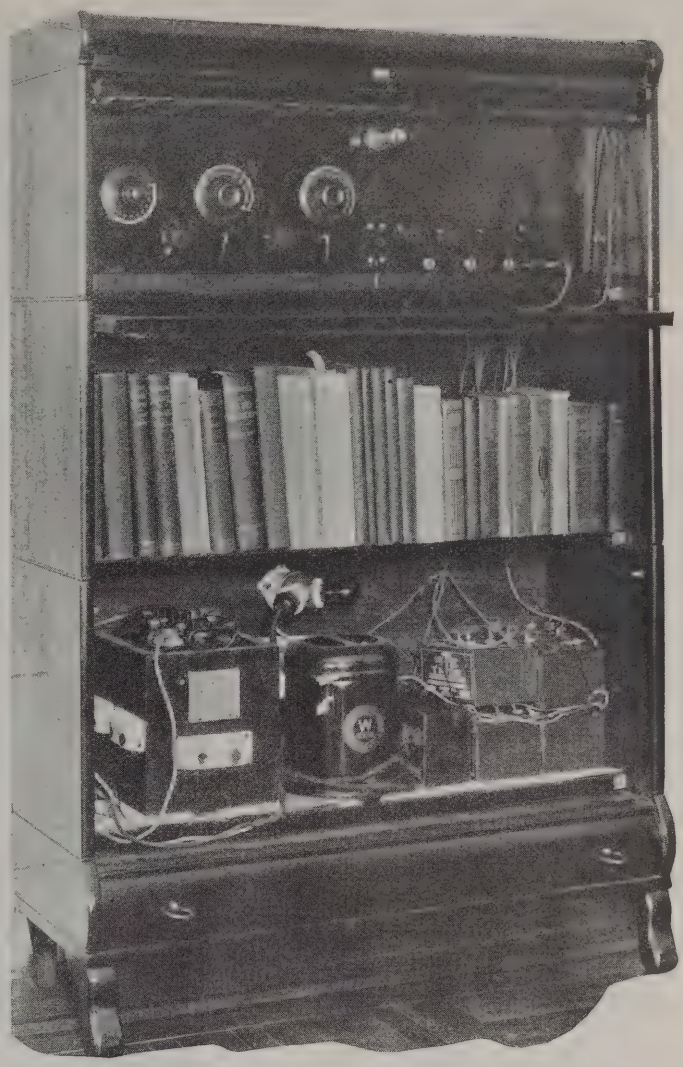
A tube rectifier is to be preferred to any other type. A chemical rectifier is of course absolutely out of the question in a living room, as the chemicals would very quickly destroy the finish of any piece of furniture. These chemicals would be "given off" while the battery is charging owing to the fact that the rectifier gasses at this time, and the gas carries a small amount of liquid with it. A vibrating rectifier was not chosen for the reason that the writer of this article has had several lamentable experiences in the past with rectifiers of this type sticking at the contacts and thus sending an alternating current through the battery, which action to say the least is undesirable as it is liable to damage the battery. The vacuum tube, on the other hand, opens and closes the circuit by an action corresponding to that which takes place inside of the tube used in the receiving set and it is

therefore not subject to the possibility of sticking contacts and damaged batteries. When this rectifier is placed in the bookcase and the door closed there only comes from it a gentle hum, indicating that the battery is being charged.

The diagram, figure 2, gives the scheme of connections. The double pole, double throw, charging switch has its center points connected to the battery. One end of the switch is connected to the charger and the other end to the receiving set. Great care must be taken when making these connections, to have the connections properly polarized as indicated in the diagram. With the wrong connections the battery might be discharged instead of charged or else the wrong polarity would be applied to the receiver, thereby decreasing its efficiency. The two leads from the charger are colored, one red and the other black. The red lead is the positive and the black the negative. The battery will either be marked in a similar manner or else the symbols for positive and negative will be marked on the battery.

There is provided inside of the bookcase, a porcelain socket containing a double socket or two-plug adapter. The plug on the rectifier is connected into one of these positions and into the other there is screwed a small green light. From this porcelain socket runs a double silk covered wire to the nearest baseboard plug. In order to place the battery on charge the switch is thrown to the charging position and the plug is placed in the baseboard socket. The small green light is then lighted and the rectifier commences charging the battery immediately. The green light indicates that the battery is on charge and prevents us from going away and forgetting it.

One reason for maintaining the battery fully charged is because the battery will last much longer under those conditions and another is because of the fact that a battery which is discharged consumes a greater amount of power to bring it up from a state of very low charge to full charge than it would to maintain it at full charge by charging slowly and often.



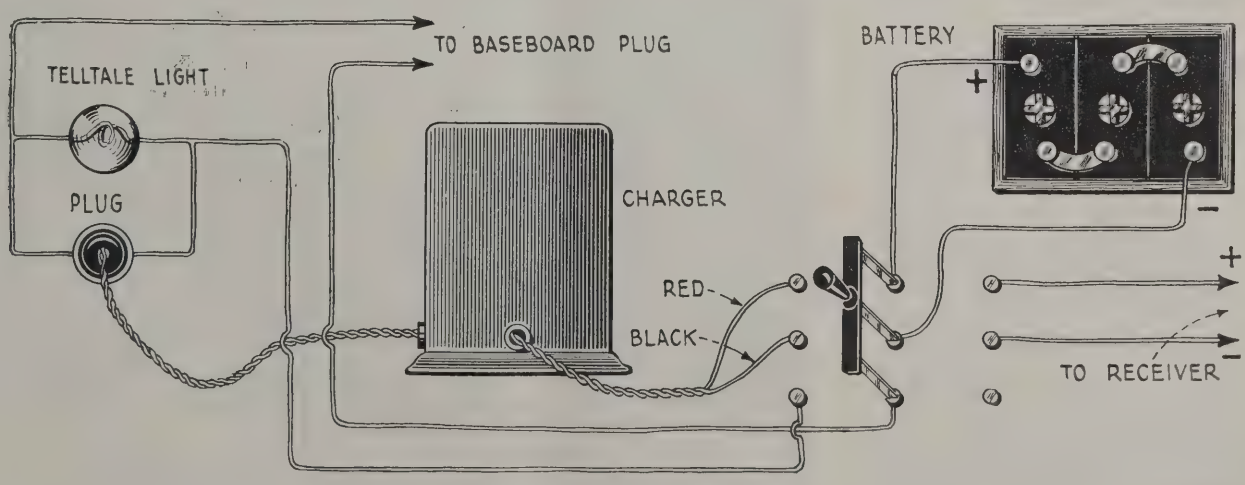
The electric light in the bottom compartment warns that the battery is recharging. This compartment is kept covered by the sliding curtained glass door

The Hydrometer

The instrument best suited for determining the state of charge of the storage battery is the hydrometer. This is the only really reliable instrument for use by those who have not had a great deal of experience with storage batteries, though there are other devices which may be used after one has gained experience. The instructions for the use of the hydrometer will be found contained with that instrument and it is then only necessary to charge the battery until the reading on the hydrometer corresponds with the reading specified by the manufacturer.

When the hydrometer is of the commonly used syringe type the lower end is inserted into the solution, the bulb is squeezed and then again released, allowing the liquid from the battery to flow upward into the bulb carrying the hydrometer float. The beginner very seldom takes care that his hydrometer is in an exactly vertical position and as a result the float sticks to the side of the containing tube and therefore does not rise as high as it should, thus indicating partial charge when the battery may be fully charged.

(*Continued on page 78*)



No bother about recharging! If the battery and charger are connected to switch as shown in this diagram the battery is set for recharging by a simple throw of the switch

RADIO NEWS FROM ALL OVER THE WORLD

Marconi Improves Directional Control of Radio Waves

GUGLIELMO MARCONI in a recent statement declares he has accomplished directional or "beam" radio transmission. He says:

"I have been experimenting for the past two years in new methods of transmission by which energy, instead of being scattered all around, is concentrated in one direction.

"By my device waves would go in a straight line from one station to another. One advantage is that a smaller amount of power is necessary and the stations would be less expensive to construct and to operate.

"I have made successful experiments in sending messages from Cape Verde to Cornwall on a beam, a distance of 2,200 miles, and I am about to experiment with messages from here to South America, 5,000 miles.

"The new methods would enable stations to be directed and worked much more efficiently and economically than now. It allows greater speed in transmission and the secrecy of the wireless would be greatly increased, with the risk of interception small.

"You could have a station in the United States broadcasting to England and only to England with much more efficiency and clearness than at present. In time we might send messages to Canada and elsewhere in the empire without any danger of their being received by other nations."

Broadcasting in China

RADIO development is taking place at a rapid pace in Hongkong, There are two transmitting stations and 500 receiving sets in use in that city and it is estimated that this number will be increased fully 100 per cent. within the next twelve months. Radio telephony makes a strong appeal to the Chinese, who have a love of anything mysterious, and there is little doubt that South China, for which Hongkong is the distributing center, is a good potential market for radio equipment.

No definite action has yet been taken by the colonial authorities in regard to the use of radio sets in the colony. Broadcasting and receiving sets are operated subject to the approval of the Executive Committee of the Hongkong Radio Society. Private individuals are permitted to set up wireless receiving sets, on the condition that due precautions are taken to prevent reradiation by receiving apparatus.

RADIO IN POLITICS
Senator Hiram W. Johnson tuning in at Presidential Campaign Headquarters. The possibilities of radio in politics offer a wide scope for speculation

Correcting a Statement on Major Armstrong

IN the pictorial section of our March issue there appeared a statement to the effect that Major Edwin H. Armstrong was "one of the foremost radio engineers of the Radio Corporation of America." This statement was incorrect. The RCA is licensed to use Major Armstrong's inventions, but he has never been in the employ of the Corporation. During the past ten years, Major Armstrong has been connected with the Marcellus Hartley Research Laboratory of Columbia University, where he is still conducting his experimental work.

Canada's Largest Broadcast Station

THE largest and most powerful radio station in Canada, located in Ottawa and operated by the Canadian National Railways as the first of a chain which it is hoped will be extended across Canada, went on the air February 27, with a program of musical selections and a talk by Sir Henry W. Thornton, chairman and president of the board of directors. The new station expects to have a range beyond that of any station in Canada.

The new station will sign CKCH and will broadcast on a wave of 435 meters.

Broadcasting will take place Wednesday and Saturday evenings with occasional church services on Sundays.

New York Schools Use Radio

WHEN the Board of Education, in co-operation with the Radio Corporation of America, broadcasts its daily school program more than eighty schools in the city can listen in through receiving sets erected in the auditorium or the principal's office.

With official school programs being broadcast almost every day it is expected that it will not be long before every school in the city will have a radio receiving set.

McAdoo Plans Campaign by Radio

WILLIAM G. McADOO'S plans to capture the Democratic Presidential nomination includes the expenditure of $30,000 in the construction of a broadcasting plant at his home in Los Angeles.

Mr. McAdoo announced that he would make use of the radiophone broadcasting station instead of undertaking extensive speaking tours, if a permit of the Department of Commerce was granted. He added that he would speak at varying hours of the day and night and that the apparatus would be powerful enough to reach all parts of the country.

Radio Beacon Aids Aircraft

RECENTLY an airplane flew to Dayton from a point a hundred miles away, the pilot depending for guidance entirely upon the signals received from a new type of radio beacon. In his receiver he heard the letters A and T transmitted in telegraph code and repeated over and over. As long as he flew along the correct course both letters were equally loud, but the moment he got off the course to one side or the other one letter became noticeably louder than the other and showed him which way to turn to get back. An ordinary airplane receiving set was used.

This radio beacon station consists of two coil antennas placed so as to cross each other at an angle of 135 degrees. Each consists of a single turn of wire 100 feet long and 50 feet high. The transmitting set is automatically connected first to one and then to the other, one letter of the signal being sent over each. The signal from an antenna of this type varies from a maximum in the plane of the coil to almost zero at righ angles. A receiving set located along the line bisecting the angle between the coils will therefore receive signals of equal intensity from both, and the ship or airplane carrying the receiving set can thus be guided along this line in either direction, and without regard to conditions of visibility.

Steering the steamship "Alberta" by radio directions without the aid of the usual navigating instruments

Radio in Greece

SOME months ago the Revolutionary Government forbade by legal decree the operating of private wireless apparatus in Greece. This measure was taken largely to prevent the Greek public from being reached with propaganda unfavorable to the Revolution, it is reported.

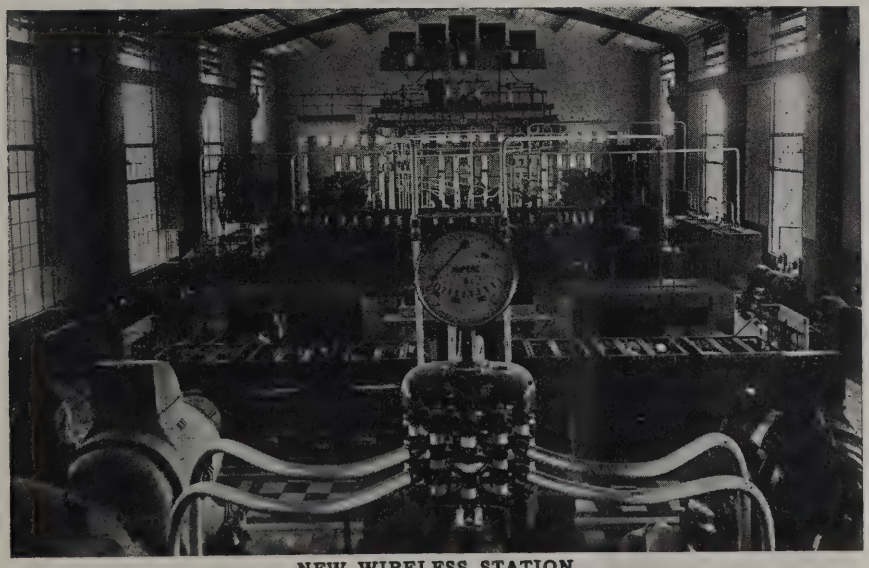
According to unofficial advices, the Ministers of Finance and Marine of the present Government have prepared a law to be submitted to the National Assembly for ratification, by which the operation of private radio sets belonging to Greek individuals will be permitted under certain restrictions and subject to the payment of a license tax.

Radio on Illinois Farms

REPLIES from 73 Illinois county farm bureaus in a radio survey just completed by the Illinois Agricultural Association revealed that there are 20,845 radio receiving sets on farms in these counties. The survey would indicate that between seven and ten per cent. of the rural population of the state have installed receiving sets.

Only about 25 per cent. of the farmers owning radio sets make their own, the rest being manufactured sets, the survey shows.

One point that was stressed was the necessity of having farm programs early in the evening, since the ten o'clock programs are rather late for farmers. "Make it snappy," was also the advice given regarding farm programs. Plenty of jazz music, and talks that are short and to the point. It is as easy to tune out a tiresome speech as it is to tune it in, they said.



NEW WIRELESS STATION

New radio station at Monte Grande, Buenos Aires, Argentine Republic. In the foreground are seen the tops of the great high frequency alternators that stand higher than a man's head. They generate a 6,000-cycle current of 1,000 amperes with a voltage of 750, and are capable of producing frequencies varying between 11,000 and 44,000 cycles. The control platform shows in the middle background. The reel-like objects in the background at either side of the room are the oscillation transformers and beneath them are groups of condensers

Radio Wave Phenomena

THE long accepted explanation of the blueness of the sky as being due to the well understood action of the sun's rays upon particles in the atmosphere is challenged, according to the *Daily Mail's* Copenhagen correspondent, by Prof. Vigard of Christiania University.

Prof. Vigard claims a discovery suggesting that the atmosphere of the earth outside the air stratum is shut up as if in a balloon whose wall consists of a solid mass of crystalline particles of nitrogen. It is this, he says, which gives the sky its blue color and it also accounts for several other phenomena, including the fact that radio waves follow the contour of the earth instead of flying from it at a tangent and losing themselves in the ether.

A scientific commentator says the discovery may prove of immense value, helping toward an understanding of radio phenomena. Incidentally, he adds, it would if proven true show that radio communication with other planets was impossible.

In Berkeley, Cal., the police, by means of radio sets installed in the department automobiles, have a rapid means of communication for emergencies

Danish Ferryboats Transmit Radiograms

DANISH ferryboats plying between ports of the Baltic carry radio now and have agreed to transmit radiograms for the patrons of the line. German ferryboats on the Gedser-Warnemude run have not as yet started transmitting.

This application of radio on inland water routes is surprising in Denmark, since a recent census lists only 3200 receiving fans, out of a population of about 3,225,000. Among the classes chiefly interested are recorded 602 students and pupils, 334 electricians, 341 craftsmen, 320 retired persons and 52 farmers.

Radio in the Polar Regions

AN interesting illustration of the value of wireless as a means of enabling a ship, in whatever part of the world she may be, to communicate with land, is provided by the fact that two Norwegian vessels, one in the Arctic and the other in the Antarctic, have been in telegraphic touch with their own country.

The Norwegian flag is now represented further north and further south than that of any other country, by the *Maud,* and the *Sir James Clark Ross.* The *Maud,* Captain Amundsen's vessel, which is attempting to drift across the North Polar basin, is now lying off the New Siberian Islands. She is equipped with a Marconi 1½ kw. tube transmitter, and is in communication with the Spitzbergen Radio Station, more than a thousand nautical miles away.

The *Sir James Clark Ross* is on a whaling expedition in the Ross Sea. Her wireless apparatus includes a Marconi 3 kw. tube transmitter, which enables her to communicate with the Awarua Radio Station, New Zealand, some seventeen hundred nautical miles to the northward. At 3 p. m. on January 22nd, when the *Sir James Clark Ross* was in latitude 78 degrees 30 minutes south, the Norsk Marconikompani handed in a regular message at the telegraph office at Christiania to be forwarded to the vessel. The message was sent via England, Australia, and Awarua Radio. The reply, which was sent by the same route, was received in Christiania at 5 a.m. on January 24th.

Radio Boom in England

MORE than 12,260 miles of aerial wire have been erected in Great Britain in the past twelve months, so much has the radio craze seized the public. It is estimated by officials of the British Broadcasting Company that 2,000,000 persons are entertained daily at a cost of a farthing each.

Radio Shows

THE Pacific Coast radio show will be held in San Francisco's Exposition Auditorium from August 16 to 21, the Radio Trades Association announces. Extensive plans to make the exhibition the biggest ever held in the West are now being formulated.

The show will be advertised with a fund of $10,000 which is now being raised for that purpose. A. S. Lindstrom heads the committee directing the radio exposition.

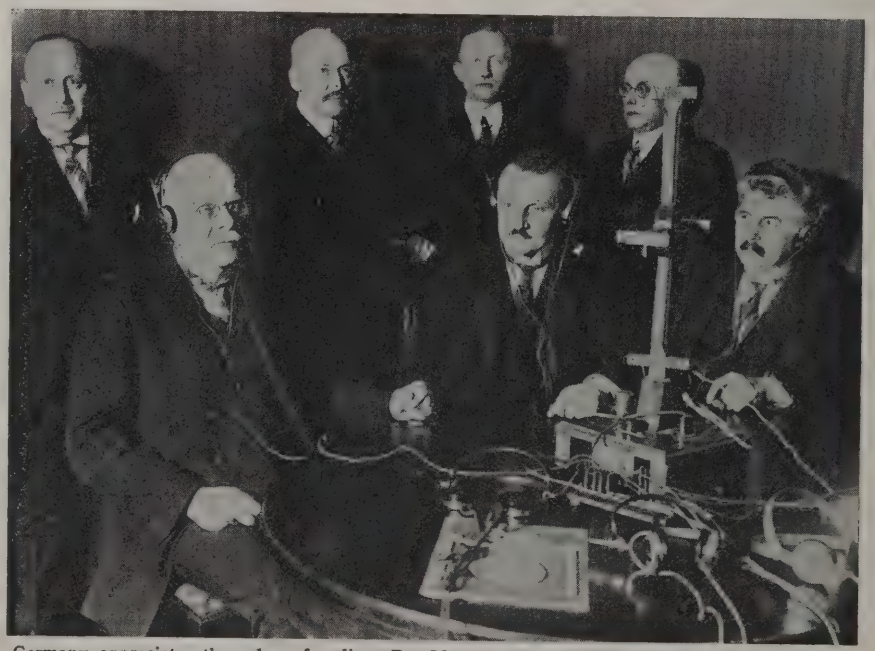
The American Radio Exposition Company announces the dates of the third annual radio show at the Grand Central Palace, New York City, as October 2-8, 1924. The ground and mezzanine floors will be used for exhibition purposes. The show will be profit-sharing in character as between the exhibitors and the management.

Radio will be featured at the electrical exhibition to be held at Melbourne, Australia, in September, 1924.

Railroads to Install Radio Train Control

AUTOMATIC train control by radio will be installed on at least one division of forty-nine first class roads of the country by 1925, it was announced at the opening session of the fourteenth annual convention of the Association of Railway Electrical Engineers.

Radio holds possibilities of intercommunication between moving trains and fixed points for personal wire or phone service and holds more promise of real value in the future than broadcast reception.



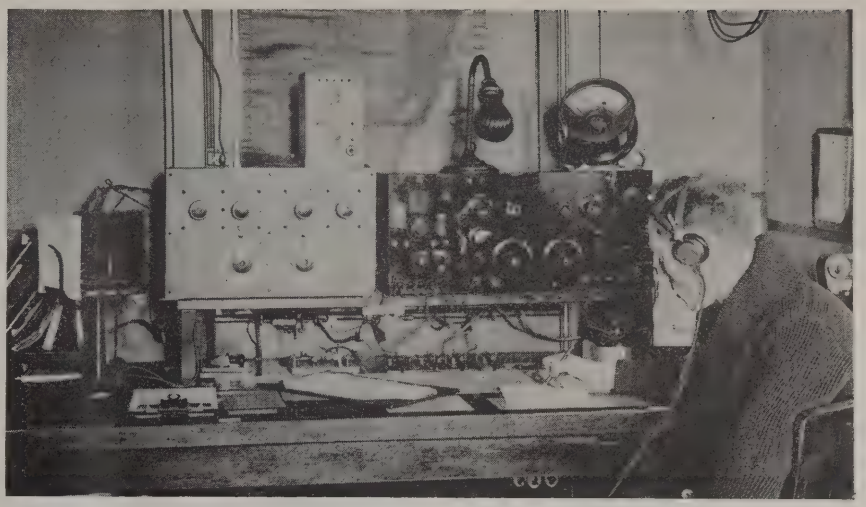
Germany appreciates the value of radio. Dr. Marx, the Premier, at the left, with Ministers Schole (center) and Fischer (right) are here shown listening in

Spanish Bull-Fights for Radio Fans

KING Alfonso has granted a British concession for broadcasting throughout Spain, and a central station and apparatus factory is shortly to be erected in Madrid.

D. H. Brayne, wireless expert at the Hotel Cecil, who has been offered an official position there, said that interest in wireless has reached such a pitch in Spain that within a few months transmitting stations will be erected throughout the country to enable even the humblest peasant to listen-in.

"This opens up an entirely new field to the listener-in," he said. "Spanish dance music will be heard in London and it is conceivable that some of the clamor and enthusiasm of the bull-ring will be heard by those who care to listen for it this summer."



MEDICAL ASSISTANCE FOR SAILORS AT SEA

Station WNY where medical advice is radioed daily to ships at sea calling for such assistance on behalf of crews or passengers. The requests are relayed to a marine hospital where diagnosis is made and treatment prescribed which is then sent by radio from the shore station. This valuable service inaugurated by the Seamen's Church Institute is carried on by the Radio Corporation of America and the U. S. Public Health Service

Radio Men Lost in Vera Cruz Storm

ADVICES to the State Department from American Consul Wood at Vera Cruz revealed that Captain Herbert G. Sparrow and three radio men had lost their lives when the cruiser *Tacoma* broke up on the rocks in a heavy storm. The Consul had previously reported that the captain and two radio men had been killed. The dead are:

Captain Herbert G. Sparrow, U. S. N.; and radio operators Edward T. Herrick, Homer H. Lussier and Solomon Sivin.

British Broadcasters Try to Reach America

IN the evening of March 13th the combined stations of the British Broadcasting Company tried to reach America with a program sent out simultaneously from their eight high-powered stations. The results were unsatisfactory, although a few persons on our Atlantic seaboard with specially powerful receiving sets were able to get portions of this concert.

Broadcasting Makes a Giant Stretch

(*Continued from page 29*)

which is picked up at Hastings and in Manchester, England. Not only does the receiving station rebroadcast at the usual broadcasting frequency for direct reception within its range, but it can also retransmit at a second high frequency to a third more distant station when such a step may be desirable.

Much experiment was involved in the determination of the precise carrier wave frequency that would give the maximum constant strength of signal, particularly during usual broadcasting hours. This was shown to be about 3333 kilocycles. Subsequently 3200 kc. was determined upon. The receiving equipment had to be designed to meet high requirements as to sensitivity, ease of frequency control, avoidance of effect from powerful local transmitter and avoidance of body capacity effects. A circuit depending upon the standard regenerative principle was used. The circuit of the receiver used at Hastings is shown in the figure herewith. This tuner requires an inverted L antenna for sensitivity and a small loop against interference from the local station. L_1, C_1 and R_1 comprise the balancing loop. The phase and the amplitude of the inductive component are adjusted by rotating the loop antenna.

All parts enclosed by the dotted line are built into one unit having filter systems in the ungrounded leads to minimize the capacity effect of the operator's body. L_2, L_3, C_3 and C_4 comprise this filter. A wave trap L_4 and C_5 is also provided in series with the antenna to exclude as much of the undesired frequency as possible. A single step "back to back" amplifier further amplifies the signals and feeds the telephone line leading to the transmitter.

The speech received from the relay receiver, or over telephone lines from the studio in the business section of Hastings, is amplified by one five-watt, double or push-pull amplifier and one 50-watt double amplifier.

A rectifier supplying direct current at 10,000 volts, a filter composed of four 4-mfd. condenser units and one inductance unit with a value of 20 henries, a modulator panel and an oscillator panel complete the transmitter unit.

The vast possibilities of this method of extending the scope of broadcasting are evident when it is stated that a thousand high-frequency bands are available, a number much in excess of the broadcasting bands. This ground has barely been broken, it would seem, but already we have in this striking international test a vision of the magnificent structure of world-wide broadcasting that is destined soon to bless our civilization.

Prize Contest

Just Send us a Photo

Illustrating the Beauty of Radio in the Home

THE first four pages of this number present the 1924 offering of radio sets. That offering should suggest many attractive home settings that our readers can provide.

Send a snap-shot or photograph of YOUR radio set, or your FRIEND'S radio set, or BOTH, to THE WIRELESS AGE. Send as many as you wish. Tell your friends about this contest so that they, too, may enter. But do not fail to have the radio pictured as a part of the home furnishings.

For the best photograph THE WIRELESS AGE Receiver (described in this issue) will be awarded as the first prize.

Second prize, $10.

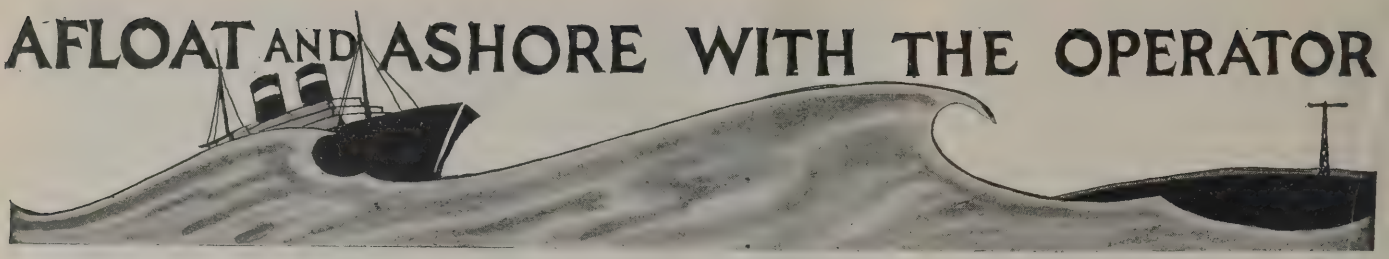
Third prize, $5.

And for the next 10 best photos, choice of a year's subscription to THE WIRELESS AGE or The Wireless Experimenter's Manual by Elmer E. Bucher, Member of Institute of Radio Engineers.

Send your snap-shot or photo to the Contest Editor before May 31st.

Contest closes May 31st

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

NOT more than four or so years ago, Rudolph L. Duncan was a radio operator possessing the usual circle of friends and acquaintances. Today he is one of the best known men in the radio field.

Behind this rapid rise there is, as in every such case, a reason. Those who have met Mr. Duncan will say his polished manner, pleasing personality and keen business sense are the factors; intimate friends who enjoy his confidence will refer to his ardent ambition, which has even brought him to the point of taking up the study of law during his spare time, and the everlasting energy which keeps him plugging and forging ahead; the hundreds of young fellows to whom he has been counsellor, adviser and friend, will point to his real character as a man, this none being better able to judge than the students who place themselves in his care.

He sees good points in every fellow who comes to him and takes a sincere interest that never swerves. In all, he's a "square shooter"—and that means much—in fact, it helped to put him where he is and it is going to boost him a whole lot higher.

Mr. Duncan started his career as a railroad telegraph operator, later taking up radio. He was a radio man in the United States Navy during the World War and also saw active service during the previous Nicaraguan and Mexican troubles. He was a chief on the naval cruiser San Diego when that vessel was torpedoed by a German submarine during the war, losing, as did other members of the crew, his entire possessions when the ship sank.

Since assuming his present position as director of the oldest radio school in America, about two years ago, Mr. Duncan has been instrumental in having more than nine hundred men secure first class government licenses, this not counting the hundreds who obtained lesser grades or amateur licenses through his coaching.

Mr. Duncan is an active member of the Institute of Radio Engineers.

△ △

AMONG the government radio hydrographic reports, there recently appeared an item showing valuable work performed by the steamer *Eugene V. R. Thayer,* and of the mariners who read it there was perhaps

Rudolph L. Duncan, one of America's leading radio educators

none who knew that the radio operator on that vessel is a young girl.

Miss Lena Michaelsen has not missed a trip on that ship during the past couple of years. She has held a first-class license and has been engaged as operator on ships for more than six years. The *Eugene V. R. Thayer* is not her first assignment.

Repair men who go to her ship—their visits are not very frequently required—report that Miss Michaelsen always dons overalls and renders real assistance, whether repairs are needed to the set, the motor-generator is to be overhauled, or a new aerial built and raised. They say she keeps her apparatus in better condition and cleaner than many men operators.

△ △

A LITTLE story we carried on this page in the February issue, about an experience of William H. Wallace on having his own signals come back to him, has started something.

Elmer G. Kopp, a traveling radio salesman out of Chicago, says that he agrees with us about Wallace being a champion, but does not care to enter the controversy claiming it to be something a regular attendant at Sunday School should keep out of.

P. J. Rowland of New Castle, Pa., on the other hand, has entered with an attempt to wrest the championship away from Wallace. Here is Mr. Rowland's letter:

"Just a line to say that 'Windy' Wallace may not be as windy as you think. Here's one from my own experience;

"About three weeks ago I was listening to WGY while a man sang a baritone solo, 'The Trumpeter.' Then as usual there was a brief intermission. I turned my condenser just a trifle and got about the last two lines of the same song in the same voice. This startled me, but I did not give it much thought. I then crawled back to WGY and heard the same man singing 'Ship Mates of Mine.' Instantly after he stopped singing I turned to the place where I had received the other echo (?) *and got the last two or three lines of the same song in the same voice.*

"Take it or leave it, this is my story and I will not back down an inch."

Next!

△ △

AN incident of radio interest recently happened in the vicinity of Irvington, N. J., for the account of which we are indebted to G. A. Chute, radio operator on the steamer *Broad Arrow.* It appears that amateurs throughout that district had been endeavoring to hear stations in England, which operate on a lower wave length than those in America. They were greatly bothered by what apparently was a local station continually testing on a low wave and making unintelligible signals. Complaints to the local government radio supervisor brought an inspector who, through the use of a direction finder located the source of the interference. It proved to be a foundry, in the smokestack of which was installed apparatus for extracting precious metals from the fumes. The apparatus was working at 85,000 volts and 45 amperes, and emitted a wave length of 130 meters.

△ △

A NEW departure in American shipping is the around-the-world passenger cruises instituted by the Dollar Steamship Company. Heretofore such cruises were made only by British and German vessels. The Dollar line has just taken over a number of the "President" ships from the Shipping Board for this service.

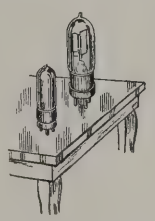
Do you know what to ask for when you buy vacuum tubes?

Tubes That Play 'Possum

The New Vacuum Tube More Efficient and More Economical

By Jerome Snyder

UNTIL a short time ago the public had been using pure tungsten filament tubes. Gradually these tubes were sold less and less until to-day the only type of tungsten filament tube sold is the detector tube UV-200. In place were substituted the well known UV-199, the UV-201A, and the WD-11 and WD-12. Although this change was not marked by any violence, as it were, it really involved a small revolution in the design of tubes. It is the purpose of this brief article to point out the essential differences between the old tungsten tubes and the new one and to explain the great advantages of the latter.



The Older Tubes Expensive to Operate

The first great disadvantage which the old tungsten tubes had was the large filament current consumption. The filament of the detector and amplifier tubes consumed one ampere. This is a relatively large current for a small receiving tube and was necessary in order to raise the tungsten filament to the high temperatures required for the necessary electron emission. Thus it required three amperes to operate the filaments of a three-tube receiver, and if such a receiver was operated for three hours an evening the drain on the storage battery would be 9 ampere-hours. Thus a forty ampere-hour battery would have to be recharged every three or four days. This is quite expensive and any improvement which decreased the upkeep cost would be a very welcome one.

Burn-Out Frequent

Then there was also the question of renewal of tubes. As mentioned above tungsten filaments have to be heated to very high temperatures (2300 to 2500 degrees Centigrade) to secure the necessary electron emission. A comparatively slight increase of temperature resulting from a little increase in current such as might be caused by varying the filament rheostat would burn out the filament, and burning out of filaments was consequently of provoking frequency.

Apart from these disadvantages there was always the great desirability of working vacuum tubes on dry batteries, thus doing away with the storage battery. Although in the long run a storage battery pays for itself, a large number of people do not want to be bothered with the care of a storage battery which is a messy proposition compared to dry cells, which, moreover, make portable receivers a possibility.

All of these considerations caused research on the development of new tubes. The result is the new tubes on the market to-day which have replaced the tungsten filament tube. Only the UV-200 gas content tube, which has a tungsten filament, still survives as a detector tube.

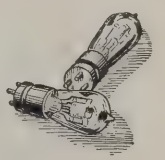
The filaments of the new tubes are called thoriated tungsten filaments and sometimes X-L filaments. The former name is really descriptive, because the filament is made of tungsten and a compound of thorium. These two are intimately mixed and then the wire is drawn. Now thorium emits electrons very copiously at a temperature of 1700 degrees Centigrade which is seen to be considerably lower than the required temperature of tungsten. So very low filament currents may be used. Thus a UV-199 tube requires only 0.06 ampere for its operation, with a terminal voltage of 3 volts. A dry cell is easily capable of furnishing such a current and three dry cells in series will easily take care of this job. In fact the drain is so small on the batteries that they last almost as long as they would if they were lying idle on the shelf. The writer has had three dry cells in use on a UV-199 tube for the past six months and they are only now beginning to go down.

A tube with low filament consumption is ideal for portable receivers. Thus it is perfectly feasible to use small flashlight batteries to light the filament, and flashlight cells take up small space and are very light. Small "B" batteries complete the battery installation for service during several weeks.

Where storage batteries are available the UV-201A tube may be used. This tube takes ¼ ampere for the filament, so for the same number of tubes the storage battery will last four times as long without charging. The second advantage of these low current thoriated tubes is that they practically never burn out, and tube life is thereby prolonged. The filaments are made with a core of tungsten, and hence the filament is capable of withstanding the usual high tungsten filament currents. However, due to the thorium compound, sufficient electron emission is secured at much lower currents.

What is the Life of a Tube?

These new tubes seldom, if ever, burn out, that is, for ordinary increases in current. Thus although the UV-201A tube takes ¼ ampere it will not burn out if this rises to ½ ampere. The function of the filament is to emit electrons so that plate current is available. If the filament stops emitting electrons, or the number of electrons emitted per second decreases to a low figure, the tube becomes useless, obviously. Now in these thoriated tubes the electrons are supplied practically solely by the thorium. When the filament is heated by the passage of the current the thorium on the surface of the wire begins to emit electrons. As the thorium on the surface is used up more thorium from inside the wire comes to the surface and replenishes the supply of electrons. Thus for a very long period of time the electron emission is normal. When the thorium finally is nearly used up the emission suddenly falls, which is evidenced by weak signals. Care should be taken that the battery is up in voltage as often the trouble is not lost emission, but simply run down batteries. Thus it will be seen that the life of these new tubes never is terminated by burned out filaments, but rather by being completely used up in service, which is very desirable. In a certain sense these thoriated filament tubes may be considered fool-proof for ordinary increases in current, since the tungsten core prevents actual filament burn-out.



(*Continued on page 82*)

YOU DON'T UNDERSTAND MA— I'VE SIMPLY GOTTA HAVE A "CAT WHISKER" TO FINISH MY SET!
COULHARD
FIRST BIRD— I'D LIKE TO TASTE ONE OF THOSE RADIO BUGS! —
SECOND BIRD— DON'T BE HASTY — IT'S LIABLE TO SHOCK YOU!!

Acquiring a Radio Set

ONE goes out and buys a hat, a player-piano or a lamp for the living room. The money is paid, and one has the hat, the player-piano or the lamp for the living-room. We never had a radio set, do not expect to have a radio set and would shoot any one we saw coming with a radio set, so our knowledge of radio is limited. But it had been our belief that one bought a radio set just as one bought a hat, a player-piano or a lamp for the living room. However, this was a mistaken belief, as was found on reading a few advertisements.

Desiring a radio set, one does not usually go out with the money and buy one, it seems. Instead, one acquires a radio set bit by bit, shopping around for some plugs, some wire, rheostats, variometers, cat's whiskers, tubes, condensers, grid leaks, coils, rectifiers, transformers and other articles with weird names. Then one puts these things together and if they are put together right gets Pittsburgh. Not content with getting Pittsburgh, one buys a potentiometer, a neutrodyne, a heterodyne and a couple of steps of amplification and gets Omaha. Dissatisfied with Omaha, one shops around some more and picks up some additional things with technical names, getting San Francisco, maybe, and even then is only a little way down the list.

It is surprising that nobody ever evolved some method of buying a car, which process now requires only the necessary money and no mechanical ingenuity. After getting a sufficient number of parts and putting them together one might make Rahway. A half dozen more and one might get to Monmouth Junction, and so on. The idea seems to have all sorts of possibilities.

—*Newark Evening News.*

THOSE BROADCAST DISPUTES

The delighted listener-in

The Making of a DX Liar

By William Harvey Bradfield

I know a certain neighbor,
Who, until a month ago,
Had never told a falsehood—
Then he took up Radio.

Now with Singapore he chatters
Every night, to hear him say;
And stations in Calcutta
Call him almost every day.

He even heard a concert
Sung in Celtic from Thibet
When I told him I had listened
To Miami with my set.

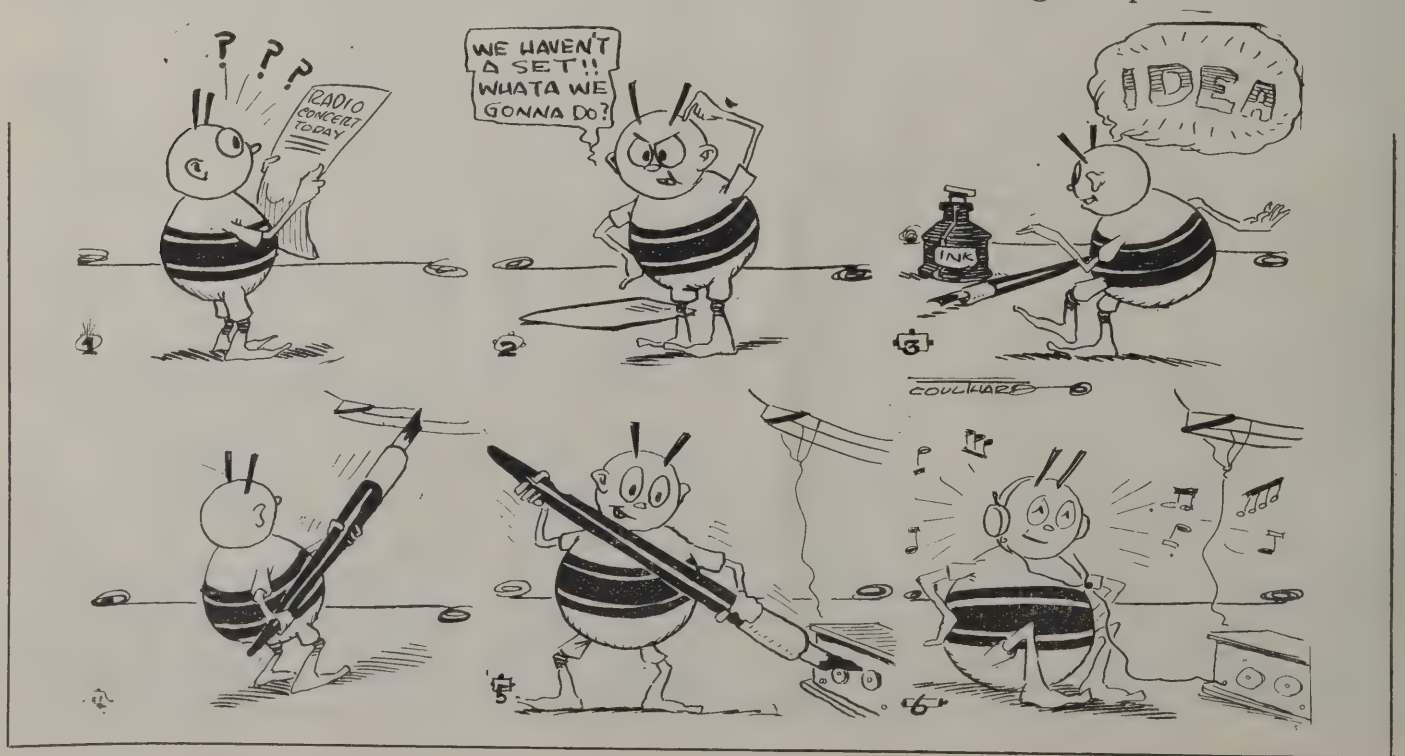
"Why, man alive!" he chortled,
That's a piker dump for true;
Last night I talked to Dublin—
Old Kilkenny Castle, too.

"Vienna spoke me early,
London said they had a fog,
Paris boulevards were crowded,
Vamps were puttin' on the dog.

"Berlin said the riots
In Mulchenhausen Square
Were making markets nervous—
Even marks were in the air."

He mentioned other station—
Constantinople and Cairo—
He who never told a white fib
Till he took up Radio.

What a Radio Bug Does When He Isn't Biting People



THE WIRELESS AGE "On the Air" Again

Did You Attend Our Last Party?

THE WIRELESS AGE has inaugurated a new broadcast feature. Many are familiar with our activities in the past in broadcasting big sporting events transmitted from Station WJZ. THE WIRELESS AGE will now entertain the radio audience regularly with diversified programs most of which will probably be musical. Our initial program broadcast from WJZ was purely musical, but future schedules will depend largely upon the suggestions received from the radio audience and our readers. H. L. W. launched our first musical program on the air from WJZ with a radical departure from the customary mode of announcing. To begin with he introduced all the entertainers, and characteristically concluded with a remark that if no one else enjoyed the program, he knew his red-headed son at home did. The great number of letters received expressing appreciation, indicates the certain success of our future parties.

"THE WIRELESS AGE Dance Orchestra" is composed of: Arthur Miller, saxaphone; Ernest Harting, saxaphone; Robert Richards, piano; Wilbur Kurz, cornet; William Schaffner, drums; Arthur Burke, violin.

Alfred Armand, our vocalist, has had a brilliant career. He has studied under operatic professors of Europe and America. He is a well-known soloist, a member of the Verdi Opera Company, and at present is a member of the Manhattan Trio which has stormed "Little Ole New York." During the war he was with the "Over-There Theatre League," entertaining the soldiers of the allied countries, and he had his share of the dangers of that period which he relates with a touch of human interest appeal. He has an interesting collection of letters of appreciation for his work from the Nobility, from Generals and all down the line to the doughboys.

The Wireless Age Orchestra

Alfred Armand

The World Within a Prison Cell

(*Continued from page* 41)

their home will keep them there and that is where they belong!

Society itself is, after all, mostly to blame for crime. It can help solve the problem by establishing a Community House in each and every town and city in our country! Then put in a good radio set and a "loud speaker" and there will always be an audience! Corner poolrooms are a breeding place of crime, but it is there that the young fellow gets the first news of all sporting events and all of us, with a bit of red blood in our veins, are interested in games and sports of all kinds. That interest has made us the foremost nation of the world! The Community House is the only thing that society has to offer to take the place of the corner poolroom. Now all sporting events of any particular importance are being broadcast. Let the young people, as well as the old people, listen-in at a clean place: namely, the Community House!

Then there are institutions of all kinds, but especially those for our defectives and delinquents, where radio would help. Society makes an awful mistake in its attitude toward those places and the unfortunate that are "behind the walls." Every man that I have talked to in prison has vowed that he is "going to get even some day!" Reform us, for we all need it, but you can't do it by depriving us of all the pleasures and even necessities of life! Give us amusements! You need a certain amount of relaxation after your day's work, but we need it far more than you do! Put a radio set in every prison then, for that is the cheapest and most convenient way of providing entertainment and amusement to the men "behind the walls." Put one in every jail, in every hospital for the insane, in every school for the feeble-minded, and in every hospital! When that is done you will find that wonderful "cures" are being made! Gloomy, morose men will become cheerful! Yes, I believe even "crooks" will become real men again!

Broadcasting to Form Character

(*Continued from page* 37)

world by bad roads and lack of railroads. "We gather around our radio set—the neighbors too—and when your story came over I wish you could have seen the response of that group!"

A little girl of 14 writes to tell Mrs. Albion how in her community they have regular church parties and there she tells to the rest Peggy Albion's stories. "And I try to say them with my voice just like yours."

Many thousands of children and many of their seniors, too—are receiving a splendid course in "character," a sugar coated course, and Peggy Albion is blessed in many a home.

What Are the Opportunities in Radio Factories?

To the Young Man Interested in Radio, There is Nothing More Interesting Than a Radio Shop—But What Does it Offer as a Future?

By M. B. Sleeper
Radio Editor and Publisher

A LONG time ago, and not so long ago either, I wanted to spend my summer's vacation doing something to make money. I went to see Mr. Eastham, who was then at the Clapp-Eastham factory. He couldn't give me a job, for summer is the quiet time for radio companies, but I remember to this day how much I appreciated his kindness in showing me through the shop. It was a place to dream about. I saw men winding coils, turning out metal parts, assembling condensers, wiring instruments, and doing all kinds of marvelous things. I met Bowden Washington, who was there inspecting some of the old double-decked loose coupler sets for the Wireless Specialty Company, and I have to this day a diagram that he drew for me of the circuit.

There's no denying it—a radio factory has, for the experimenter, a gripping fascination that nothing else can equal. I thought Mr. Eastham must be the happiest man on earth, and I knew I would be if I could wear a long shop coat too and work on radio instruments all day long. However, there is a lot of difference between looking in from the outside and looking out from the inside.

Do you want to work in a radio factory? Yes? Well—just what do you mean when you say, "Yes"? Do you want to work at an assembly bench and, by years of steady work develop into an expert assembler, or become an inspector some day, or do you expect to own a factory of your own by and by? If the successful man is the one who stays at whatever he sets out to do until he can do it better than those around him, the bench worker may be as successful as the heads of the company though, to be sure, he will not make as much money.

Let me warn you, though, that Al Grebe, for example, if he started today in the little barn shop he had a few years back, would find it a lot slower climbing than it was at the time he started in. Not only is competition very keen, but there will not be again the big boom that helped so much. Where big success came in three years then, it may take five or ten years now, and pickings for the little shops may be pretty poor unless there is plenty of energy and ambition behind them as a driving force.

But let's suppose you want to go right up to the top, to own a factory doing a half or even one or two million dollars' worth of business a year. While you may stop somewhere along the line, at least you won't go high without aiming higher. I say that because ninety-nine men out of a hundred decide, on the way, that they are ready to stop climbing for the reason that they don't feel the work and the sacrifices worth while.

Are you fitted by natural instinct and training for factory work? You needn't have yourself psycho analyzed. Look at your radio set. Is it the work of a fellow who's all thumbs, or are the wires neatly soldered and the instruments arranged in a way that shows a neat, orderly mind of naturally mechanical bent? Would that workmanship pass in a set to be sold in a store? If the answer is "No," you'd better think a lot more about yourself before you go out for a job at an assembly bench. Do you know the use—the correct use, mind you—of the drill press, lathe, coil winder, and soldering iron? Can you read a micrometer? Can you look at a screw and tell the size of the thread, or guess quite nearly the size of a drill? Do you understand the sharpening of tools? Can you make a perfect right angle bend in a piece of bus bar? How accurately can you guess the gauge of a piece of wire? Are you able to draw clear and neat diagrams, and can you read circuits so as to follow them to the letter in wiring a set? Have you had at least a year or two of mechanical drawing in school, enough that you can read blue prints intelligently?

Test yourself on these points. If you can say "Yes," to each one, you ought to get along well in a shop, but if you burn up your iron, or don't know the difference between No. 20 and 24 wire,

Assembling Room in the Radio Department of the General Electric Company. This presents a fair picture of modern quantity production applied to radio, which as an industry, has a place for great numbers of workers

Filkostat testing room of DX Instrument Company, Harrisburg, Pa. Every bit of apparatus has to be carefully tested

The assembling room of this same plant. These operations afford good steady employment for many radio workers

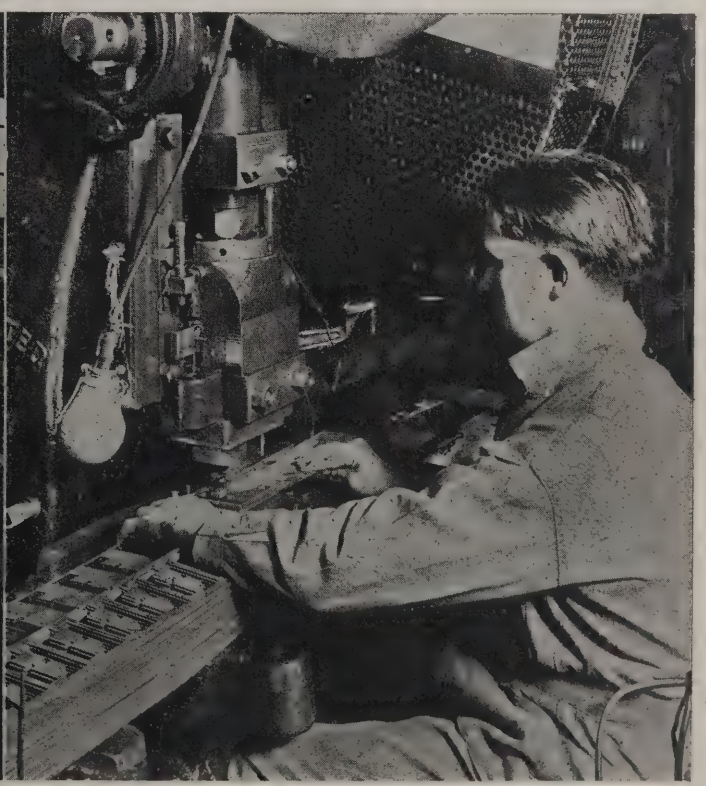
or think a 3/16 in. drill is a No. 18, they'll know it in a week's time, and if you're not discharged as incompetent, at least you'll get only the dullest, most unpleasant work to do, such as sorting out chipped knobs, or cutting up bus bar.

Another thing—are you going to be able to keep the pace? Can you get at your bench before the bell rings, work full speed until lunch, carry on steadily until the end of the day, and stay at night if overtime is necessary? It's not easy. There is always someone who will throw broken pieces of molded parts around, or tip over a box of screws to waste time picking them up, and you'll get into bad habits very quickly. It's so easy, in fact, that the man who refuses to gossip about the stations he heard last night stands out like a headlight among those around him. If you get in in the morning and back from lunch at noon early enough to have your soldering iron hot when the bell rings, the foreman will pick you for good jobs before you have been there a week.

That is as easy as it sounds until you have to do it day in and day out. Is it really worth while? You'll think so when spring comes, and the general manager asks the shop superintendent for a list of men he can let go. And later on when the factory personnel is stripped to a skeleton force during the summer. Will the super say about you, "We'd better keep him because he's too good to let go"? Indeed he will if you have made him feel that way because you've been to busy to do anything but your work. But remember, when you finish a job don't go buzzing up to the foreman with a don't-you-think-I'm-clever smile and ask for the next job. Just act as if it was the most natural thing in the world that you had finished. Don't be so anxious that you make a nuisance of yourself. If you can't get more work immediately, keep acting busy. If you know more than the man next to you, don't help him any more than you have to, for the foreman wants every man with his nose at his own job. The foreman is there to assist his men. If he doesn't, he won't thank you for doing it, so don't interfere.

When Fall comes again, the man on the bench last season, who was good enough to keep through the summer, is made an inspector or tester. If the assistant foreman didn't do well, the inspector gets his job, or whatever shake-up takes place the all-year-round man generally goes ahead. Occasionally, however, it seems as if things don't break fairly, or the raise wasn't big enough. You must remember every single minute that the men working with you are the men who will be work-

(*Continued on page* 84)



Here are shown some of the manufacturing processes at the Federal plant at Buffalo, which employs over a thousand operatives. These views show two of the multiple drills which drill all the panel holes in a single operation, also a punching press which punches out the transformer core iron

Design of Loop Antennas

PART III

Directional Properties

By Ralph Batcher, E. E.

Author of "Prepared Radio Measurements," Wireless Press

LOOP antennas have become available for use in radio reception since the advent of vacuum tube amplifiers. In two previous chapters of this article the author has taken up the design of loop antennas with rules and tables for determining the inductance of any practical size loop. In this article (which will complete the series) directional properties of loops will be discussed.

The voltage induced in a loop is the combined effect or resultant of the voltages induced by the passing wave in each of its two vertical sides. Ordinarily these voltages are nearly equal, but are not in phase due to the time taken for the wave to move across the loop. If the voltages were exactly in phase there would be no potential difference between the terminals and no signal would be produced.

From this viewpoint it will be seen that since the length of the loop is very small in comparison with the length of the wave received that the voltage cannot be large, when compared with the voltage induced in an ordinary antenna.

The angle by which the voltages in each side differs is equal to

$$\theta = \frac{2\pi l}{\lambda} \qquad (1)$$

This is apparent from figure 1, which assumes that the ether wave is stationary and that the loop moves forward with the speed of light, through one cycle. The voltage then induced in the loop as a whole is equal to

$$E_L = 2E_s \sin \frac{\theta}{2} \qquad (2)$$

Since the sine of an angle is very nearly equal to the angle, for the small angles involved equation 2 becomes

$$E_L = E_s \theta \qquad (3)$$

Combining equations 1 and 3 gives the following relation

$$E_L = Kh\theta = \frac{Khl \times 2\pi}{\lambda} \qquad (4)$$

since E_s is proportional to the height of each side. K is the proportionality factor. Thus it is seen that the effective voltage is proportional to the product of the length and height of a loop—or in other words, proportional to the area—and inversely as the wavelength. For a loop of N turns the voltage is N times as large.

It is then of vital importance to obtain the greatest area with the minimum amount of wire. This requirement calls for a circular loop, but the mechanical details prevent this type of construction so that the next best style is the square loop.

To determine the best shape ratio a comparison can be made graphically by plotting the ratio $\left(\frac{\text{Area} \times \text{Turns}}{\text{Inductance}}\right)$ against the number of turns. This has been done for one style of loop in figure 2. The same characteristics will be found with loops with other spacings, etc. This figure shows that a few large turns give very much greater signal strength than a loop having a large number of small turns, although both loops may have the same total inductance and the same wavelength range. The absolute values for the units are of no value so that arbitrary values are given only in plotting this curve. The point of interest is that if a loop can be designed to give the desired inductance with 8 turns of wire or less, much louder signals may be expected. However if over 10 turns are required disregard this consideration entirely and base the design on securing a convenient sized loop. It will be seen that a loop with five large turns is very little better than one with twenty small turns, but one with three or four still larger turns will give very much louder signals, although all may have the same inductance.

Equation 1 and figure 1 assume that the plane of the loop is at right angles to the wave front, because in this position the greatest amount of time is consumed by the wave in passing from one side to the other, and the resulting voltage is the greatest. However, if the loop is turned through some angle

(*Continued on page 55*)

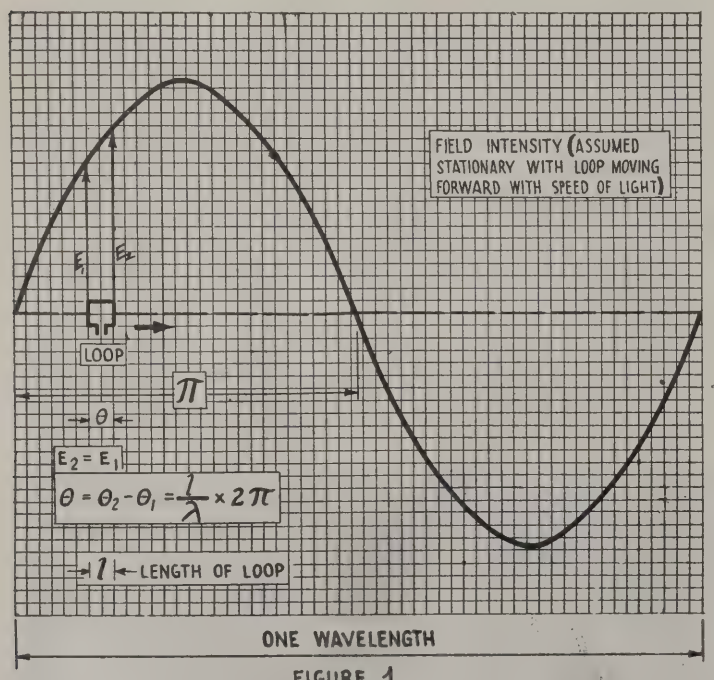

FIELD INTENSITY (ASSUMED STATIONARY WITH LOOP MOVING FORWARD WITH SPEED OF LIGHT)
LOOP
π
θ
E2 = E1
θ = θ2 - θ1 = l/λ × 2π
l LENGTH OF LOOP
ONE WAVELENGTH

FIGURE 1

Curve of field intensity

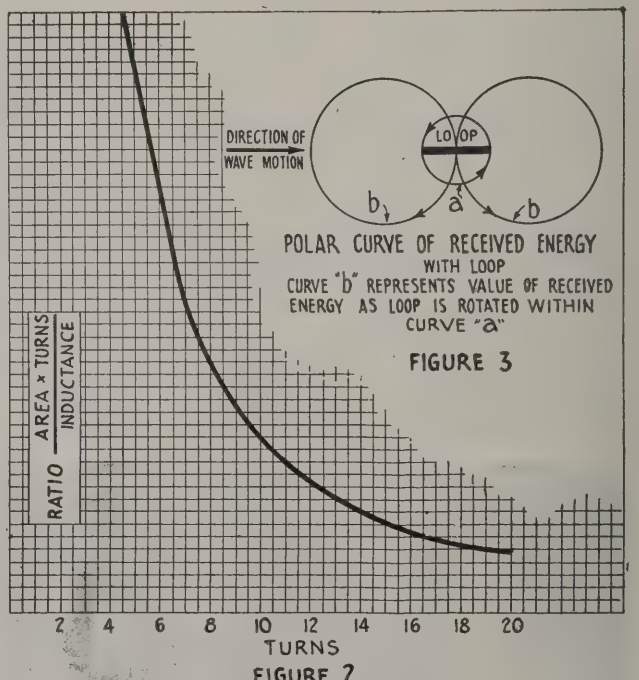

DIRECTION OF WAVE MOTION
LOOP
b1
a
b
POLAR CURVE OF RECEIVED ENERGY WITH LOOP
CURVE "b" REPRESENTS VALUE OF RECEIVED ENERGY AS LOOP IS ROTATED WITHIN CURVE "a"
RATIO AREA × TURNS / INDUCTANCE
2 4 6 8 10 12 14 16 18 20
TURNS

FIGURE 3

FIGURE 2

Polar curve of received energy

BROADCASTING STATION DIRECTORY

(Revised to March 15th, 1924)

The Most Authenic, Up-to-the-Minute List

KDKA	Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	326
KDPM	Westinghouse Electric & Mfg. Co., Cleveland, Ohio	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Telegram Publishing Co...Salt Lake City, Utah	360
KDYM	Savoy Theatre.....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology...Portland, Ore.	360
KDYW	Smith Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin.....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZF	Automobile Club of Southern California, Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing.....Denver, Colo.	360
KDZR	Bellinghom Publishing Co.....Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co....Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAO	Rhodes Co.....Seattle, Wash.	270
KFAR	Studio Lighting Service Co.....Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azbill..5038 Cliff Place, San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and The Chrnoicle News .....Trinidad, Colo.	360
KFBU	The Cathedral .....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co. .....Phoenix, Ariz.	278
KFCF	Frank A. Moore, 707 Baker Bldg., Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)...Billings, Mont.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare, 2421 Jefferson Ave., Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michaels Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agricultural College.....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. Everett Cutting, 420 W. Koch St., Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods York, Nebr.	360
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson, 2510 Thomas Ave. S., Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	360
KFEJ	Guy Greason...1724 S. Jay St., Tacoma, Wash.	360
KFEL	Winner Radio Corporation, 1435 Welton St., Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary.....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co. .....Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers, St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheffel Motor Co...Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy .....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co., Dallas, Tex. (portable)	226
KFGC	Louisiana State University..Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co...Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford University, Calif.	360
KFGJ	Missouri National Guard, One Hundred and Thirty-eighth Infantry ....St. Louis, Mo.	266
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGQ	Crary Hardware Co. .....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268
KFHA	Western State College of Colorado, Gunnison, Colo.	252
KFHB	Rialto Theatre .....Hood River, Ore.	280
KFDH	Utz Radio & Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co. .....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seattle, Wash.	283
KFHS	Clifford J. Dow .....Lihue, Hawaii	275
KFHX	Robert W. Nelson, 407 E. First St., Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.), Tenth and Hope Sts., Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage .....Iola, Kans.	246
KFIF	Benson Polytechnic Institute ....Portland, Ore.	360
KFIL	Windisch Electric Farm Equipment Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints .....Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman Fon du Lac, Wis.	273
KFJB	Marshall Electric Co. .....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash.	270
KFJF	National Radio Manufacturing Co., Oklahoma City, Okla.	252
KFJI	Liberty Theater .....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co.....Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co. ....Ottumwa, Iowa	242
KFJM	University of North Dakota, Grand Forks, N. Dak.	280
KFJQ	Electric Construction Co., Valley Radio Division Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son, Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren .....Dexter, Iowa	224
KFJW	Le Grand Radio Co. .....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co. .....Fort Dodge, Iowa	246
KFJZ	Texas National Guard, One Hundred and Twelfth Cavalry .....Fort Worth, Tex.	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association, Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray, 3200 Richardson St., Butte, Mont.	283
KFKX	Westinghouse Electric & Mfg. Co., Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co...Colorado Springs, Colo.	234
KFLA	Abner R. Wilson, 1321 W. Platinum St., Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co., Menominee, Mich.	248
KFLD	Paul E. Greenlaw .....Franklinton, La.	234
KFLE	National Education Service .....Denver, Colo.	268
KFLH	Erickson Radio Co. .....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop .....Little Rock, Ark.	261
KLFR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman, 1503 Fourth Ave., Rockford, Ill.	229
KFLW	Missoula Electric Supply Co., Missoula, Mont.	234
KFLX	George R. Clough, 1214 Fortieth St., Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co. .....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn	275
KFMT	George W. Young, 2219 N. Bryant St., Minneapolis, Minn.	231
KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Sateren, 127 Blanche St., Houghton, Mich.	266
KFMX	Carleton College .....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club....Roswell, N. Mex.	250
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College .....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop....Warrensburg, Mo.	234
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFSG	Echo Park Evangelistic Assn..Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger .....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service, 192 Park St., Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co., 1556 E. Taylor St., Portland Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony, Waikiki Beach, Honolulu, Hawaii	360
KGW	Portland Morning Oregonian.....Portland, Ore.	492
KGY	St. Martins College ..... Lacey, Wash.	258
KHJ	Times-Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer, 2020 Thirteenth Ave., Seattle, Wash.	360
KJQ	C. O. Gould, 615 E. Main St., Stockton, Calif.	360
KJR	Northwest Radio Service Co., 1328 Sixth Ave., Seattle, Wash.	283
KJS	Bible Institute of Los Angeles, 536 S. Hope St., Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., 2201 Telegraph Ave., Oakland, Calif.	360
KLX	Tribune Publishing Co. (Oakland Tribune) Oakland, Calif.	509
KLZ	Reynolds Radio Co., 1534 Glenarm Place, Denver, Colo.	360
KMJ	San Joaquin Light & Power Corporation, Fresno, Calif.	273
KMO	Love Electric Co..818 N. L St., Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co., 815 S. Main St., Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., 216 W. Third St., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture and Mechanical Arts.....State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. ..... San Francisco, Calif.	423
KQP	Apple City Radio Club, Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa.	360
KQW	Charles D. Herrold, 467 First St., San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co.....San Francisco, Calif.	380
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....Elmonte, Calif.	256
KWG	Portable Wireless Telephone Co., 530 E. Market St., Stockton, Calif.	360
KWH	Los Angeles Examiner....Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co...Modesto, Calif.	252
KYQ	The Electric Shop .....Honolulu, Hawaii	360
KYW	Westinghouse Electric & Mfg Co., Chicago, Ill.	536
KZM	Preston D. Allen, Thirteenth and Harrison Sts., Oakland, Calif.	360
KZN	The Deseret News.....Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co., Wenatchee, Wash.	360
WAAB	Valdemar Jensen, 137 S. St. Patrick St., New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	I. R. Nelson Co.....Bond St., Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	John B. Lawrence.....Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A. .....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio.	240
WABI	Bangor Railway & Electric Co....Bangor, Me.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agricultural College...Storrs, Conn.	283
WABM	F. E. Doherty Automotive & Radio Equipment Co. .....Saginaw, Mich.	254
WABN	Ott Radio (Inc.) .....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church...Rochester, N. Y.	252
WABP	Robert F. Weinig, 522 Wooster Ave., Dover, Ohio.	266
WABQ	Haverford College Radio Club...Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co., 117 Mulberry St., Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt, 1812 Fifteenth Ave. S., Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich. (near)	270
WABY	John Magaldi, Jr., 815 Kimball St., Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church.New Orleans, La.	263
WBAA	Purdue University.....West Lafayette, Ind.	360
WBAD	Sterling Electric Co., 31 S. Fifth St., Minneapolis, Minn.	360
WBAH	The Dayton Co. .....Seventh st. and Nicollet Ave., Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation, 193 Ellison St., Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Worthham-Carter Publishing Co. (Star Telegram) .....Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co., 146 N. Third St., Columbus Ohio	390
WBAX	John H. Stenger, Jr., 66 Gildersleeve St., Wilkes-Barre, Pa.	360
WBAY	Western Electric Co., 463 West St., New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service, Fourth and Walnut Sts., Reading, Pa.	234
WBBE	Alfred R. Marcy, 113 W. Raynor Ave., Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya, 24 Vermilya St., Mattapoisett, Mass.	240
WBBH	J. Irving Bell, 1511 Gordon St., Port Huron, Mich.	246
WBBI	Indianapolis Radio Club, 1721 N. Somerset St., Indianapolis, Ind.	234
WBBJ	Neel Electric Co., West Palm Beach, Fla.	258
WBBK	Kaufmann & Baer Co.....Pittsburgh, Pa.	254
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co., 110 Park Place, Lincoln, Ill.	226
WBBO	Michigan Limestone & Chemical Co., Rogers, Mich.	250
WBL	T. & H. Radio Co.....Anthony, Kans.	261
WBS	D. W. May (Inc.), 325 Central Ave., Newark, N. J.	360
WBT	Southern Radio Corporation, 1116 Realty Bldg., Charlotte, N. C.	360
WBZ	Westinghouse Electric & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall, 2813 Calhoun St., New Orleans, La.	268
WCAH	Entrekin Electric Co., 321 W. Tenth St., Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel, 2504 Bagby St., Houston, Tex.	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WBBN	A. B. Blake, 25 N. Front St., Wilmington, N. C.	275
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook.150 Exchange St., Pawtucket, R. I.	252
WBBR	Peoples Pulpit Association.....Rossville, N. Y.	244
WCAP	Chesapeake & Potomac Telephone Co., Washington, D. C.	469

WCAR Alamo Radio Electric Co., 608 W. Evergreen St., San Antonio, Tex. 360
WCAS William Hood Dunwoody Industrial Institute, Minneapolis, Minn. 246
WCAT South Dakota State School of Mines, Rapid City, S. Dak. 240
WCAU Durham & Co., 1936 Market St., Philadelphia, Pa. 286
WCAV J. C. Dice Electric Co., 113 W. Capitol Ave., Little Rock, Ark. 360
WCAX University of Vermont.....Burlington, Vt. 360
WCAY Kesselman O'Driscoll Co., 517 Grand Ave., Wilwaukee, Wis. 261
WCAZ Carthage College.....Carthage, Ill. 246
WCBA Charles W. Heimbach, 1015 Allen St., Allentown, Pa. 280
WCBC University of Michigan.....Ann Arbor, Mich. 280
WCBD Wilbur G. Voliva.....Zion, Ill. 345
WCK Stix-Baer & Fuller Dry Goods Co., St. Louis, Mo. 360
WCM University of Texas.....Austin, Tex. 360
WCX Detroit Free Press.....Detroit, Mich. 517
WDAE Tampa Daily Times.....Tampa, Fla. 360
WDAF Kansas City Star.....Kansas City, Mo. 411
WDAG J. Laurance Martin.....Amarillo, Tex. 263
WDAH Trinity Methodist Church (South), El Paso, Tex. 268
WDAK The Courant.....Hartford, Conn. 261
WDAO Automotive Electric Co., Ervay and Corsicana Sts., Dallas, Tex. 360
WDAP Board of Trade.....Chicago, Ill. 360
WDAR Lit Brothers.....Philadelphia, Pa. 395
WDAS Samuel A. Waite, 692a Main St., Worcester, Mass. 360
WDAU Slocum & Kilburn, 23 N. Water St., New Bedford, Mass. 360
WDAY Radio Equipment Corporation, 117 Broadway, Fargo, N. Dak. 244
WDBC Kirk, Johnson & Co., Lancaster, Pa. 258
WDM Church of the Covenant, Washington, D. C. 234
WDZ James L. Bush.....Tuscola, Ill. 278
WEAA Frank D. Faliain....Police Bldg., Flint., Mich. 280
WEAF American Telephone & Telegraph Co., 24 Walker St., New York, N. Y. 492
WEAH Witchita Board of Trade.....Wichita, Kans. 280
WEAI Cornell University.....Ithaca, N. Y. 286
WEAJ University of South Dakota, Vermilion, S. Dak. 283
WEAM Borough of North Plainfield, North Plainfield, N. J. 252
WEAN Shepard Co.....Providence, R. I. 273
WEAO Ohio State University.....Columbus, Ohio 360
WEAP Mobile Radio Co., O'Gwinn Bldg., Mobile, Ala. 360
WEAR Baltimore American and News Publishing Co., Baltimore, Md. 360
WEAS Hecht Co.....Washington, D. C. 360
WEAU Davidson Bros. Co.....Sioux City, Iowa 360
WEAY Iris Theatre.....Houston, Tex. 360
WEB Benwood Co.....1110 Olive St., St. Louis, Mo. 360
WEV Hurlburt-Still Electrical Co., McKinley Ave. and San Jacinto St., Houston, Tex. 360
WEW St. Louis University.....St. Louis, Mo. 261
WFAA Dallas News and Dallas Journal....Dallas, Tex. 476
WFAB Carl F. Woese.802 McBride St., Syracuse, N. Y. 234
WFAF H. C. Spratley Radio Co., 357 Main St., Poughkeepsie, N. Y. 360
WFAH Electric Supply Co., 637 Procter St., Port Arthur, Tex. 236
WFAJ Hi-Grade Wireless Instrument Co., 25 Hanover St., Asheville, N. C. 360
WFAM Times Publishing Co.....St. Cloud, Minn. 360
WFAN Hutchinson Electric Service Co., Hutchinson, Minn. 360
WFAQ Missouri Wesleyan College.....Cameron, Mo. 360
WFAT New Columbus College....Sioux Falls, S. Dak. 258
WFAV University of Nebraska.....Lincoln, Nebr. 275
WFI Strawbridge & Clothier.....Philadelphia, Pa. 395
WGAL Lancaster Electric Supply and Construction Co., 23 E. Orange St., Lancaster, Pa. 248
WGAN Cecil E. Lloyd, 216 W. Romana St., Pensacola, Fla. 360
WGAQ Glenwood Radio Corporation, 900 Texas Ave., Shreveport, La. 360
WGAW Ernest C. Albright, 1918 W. Chestnut St., Altoona, Pa. 261
WGAZ South Bend Tribune.....South Bend, Ind. 360
WGI American Radio and Research Corporation, Medford Hillside, Mass. 360
WGL Thomas F. J. Howlett, 2303 N. Broad St., Philadelphia, Pa. 360
WGR Federal Telephone & Telegraph Co., Buffalo, N. Y. 319
WGV Interstate Electric Co., 356 Barrone St., New Orleans, La. 242
WGY General Electric Co.....Schenectady, N. Y. 380
WHA University of Wisconsin.....Madison, Wis. 360
WHAA State University of Iowa....Iowa City, Iowa 283
WHAB Clark W. Thompson.....Galveston, Tex. 360
WHAD Marquette University.....Milwaukee, Wis. 280
WHAG University of Cincinnati.....Cincinnati, Ohio 222
WHAH Hafer Supply Co., 112 W. Sixth St., Joplin, Mo. 283
WHAK Roberts Hardware Co.....Clarksburg, W. Va. 258
WHAM University of Rochester (Eastman School of Music).....Rochester, N. Y. 283
WHAP Otta and Kuhns, 160 S. Water St., Decatur, Ill. 360
WHAR Paramount Radio & Electric Co., 17½ S. Virginia Ave., Atlantic City, N. J. 231
WHAS Courier-Journal and Louisville Times, Louisville, Ky. 400
WHAV Wilmington Electrical Specialty Co., 405 Delaware Ave., Wilmington, Del. 360
WHAZ Rensselaer Polytechnic Institute..Troy, N. Y. 380
WHB Sweeney School Co., Sweeney Bldg., Kansas City, Mo. 411
WHK Radiovox Co., 5005 Euclid Ave., Cleveland, Ohio. 283
WHN George Schubel, 1540 Broadway, New York, N. Y. 360
WIAB Joslyn Automobile Co., 320 Church St., Rockford, Ill. 252
WIAC Galveston Tribune.....Galveston, Tex. 360
WIAD Howard R. Miller, 6318 N. Park Ave., Ocean City, N. J. 254
WIAF Gustav A. DeCortin, 139 N. Alexander St., New Orleans, La. 234
WIAI Heer Stores Co.....Springfield, Mo. 252
WIAJ Fox River Valley Radio Supply Co., 425 Sherry St., Neenah, Wis. 224
WIAK Journal-Stockman Co.....Omaha, Nebr. 278
WIAO School of Engineering of Milwaukee, 415 Marshall St., Milwaukee, Wis. 360
WIAQ Chronicle Publishing Co., 413 S. Washington St., Marion, Ind. 226
WIAR Paducah Evening Sun.....Paducah, Ky. 360

WIAS Home Electric Co., 315 N. Third St., Burlington, Iowa. 360
WIAU American Trust & Savings Bank.Le Mars, Iowa. 360
WIK K. and L. Electric Co., 427 Olive St., McKeesport, Pa. 234
WIL Continental Electrical Supply Co., 808 Ninth St., Washington, D. C. 360
WIP Gimbel Bros. .....Philadelphia, Pa. 509
WJAD Jackson's Radio Engineering Laboratories, 801 Austin St., Waco, Tex. 360
WJAF Muncie Press and Smith Electric Co., Muncie, Ind. 360
WJAK Clifford L. White.....Greentown, Ind. 254
WJAM D. M. Perham, 332 Third Ave., West, Cedar Rapids, Iowa 268
WJAN Peoria Star.....Peoria, Ill. 280
WJAQ Capper Publications.....Topeka, Kans. 360
WJAR The Outlet Co.....Providence, R. I. 360
WJAG Norfolk Daily News.....Norfolk, Nebr. 283
WJAS Pittsburgh Radio Supply House, 963 Liberty Ave., Pittsburgh, Pa. 250
WJAT Kelley-Vawter Jewelry Co.....Marshall, Mo. 360
WJAX Union Trust Co.....Cleveland, Ohio 390
WJAZ Chicago Radio Laboratory, 332 S. Michigan Ave., Chicago, Ill. 448
WJD Denison University .....Granville, Ohio 229
WJH William P. Boyer Co., 812 Thirteenth St. N. W., Washington, D. C. 273
WJX Deforest Radio Telephone and Telegraph Co. 1391 Sedgwick Ave., New York, N. Y. 360
WJY Radio Corporation of America..New York, N. Y. 405
WJZ Radio Corporation of America..New York, N. Y. 455
WKAA H. F. Paar.....Cedar Rapids, Iowa 286
WKAD Charles Loeff (Crescent Park), East Providence, R. I. 240
WKAF W. S. Radio Supply Co., 725 Tenth St., Wichita Falls, Tex. 360
WKAN United Battery Service Co...Montgomery, Ala. 226
WKAP Dutee W. Flint.....Cranston, R. I. 360
WKAQ Radio Corporation of Porto Rico, San Juan, P. R. 360
WKAR Michigan Agriculture College, East Lansing, Mich. 280
WKAV Laconia Radio Club.....Laconia, N. H. 254
WKAY Brenau College .....Gainesville, Ga. 280
WKY W K Y Radio Shop.....Oklahoma, Okla. 360
WLAG Cutting & Washington Radio Corporation, 18 W. Franklin St., Minneapolis, Minn. 417
WLAH Samuel Woodworth, 425 Brownell St., Syracuse, N. Y. 234
WLAJ Waco Electrical Supply Co., 616 Austin Ave., Waco, Tex. 360
WLAK Vermont Farm Machine Corp., Bellows Falls, Vt. 360
WLAL Naylor Electrical Co., 24 W. Second St., Tulsa, Okla. 360
WLAP W. V. Jordan.....Louisville, Ky. 360
WLAQ Arthur E. Schilling, 108 Elm St., Kalamazoo, Mich. 283
WLAV Electric Shop, 30 S. Palafox St., Pensacola, Fla. 254
WLAW Police Department, City of New York, New York, N. Y. 360
WLAX Putnam Electric Co. (Greencastle community broadcasting station) ....Greencastle, Ind. 231
WLB University of Minnesota....Minneapolis, Minn. 360
WLW Crosley Radio Corporation.....Cincinnati, Ohio 309
WMAB Radio Supply Co., 707 N. Broadway, Oklahoma, Okla. 360
WMAC Clive B. Meredith, Fernwood St., Cazenovia, N. Y. 261
WMAF Round Hills Radio Corp.....Dartmouth, Mass. 360
WMAH General Supply Co., 144 N. Thirteenth St., Lincoln, Nebr. 254
WMAJ Drovers Telegram Co.....Kansas City, Mo. 275
WMAK Norton Laboratories.....Lockport, N. Y. 360
WMAL Trenton Hardware Co., 35 E. State St., Trenton, N. J. 256
WMAN First Baptist Church.....Columbus, Ohio 286
WMAP Utility Battery Service, 665 Northampton St., Easton, Pa. 246
WMAQ Chicago Daily News.....Chicago, Ill. 448
WMAV Alabama Polytechnic Institute, Auburn, Ala. 250
WMAW Wahpeton Electric Co....Wahpeton, N. Dak. 254
WMAY Kingshighway Presbyterian Church, St. Louis, Mo. 280
WMAZ Mercer University .....Macon, Ga. 268
WMC Commercial Appeal .....Memphis, Tenn. 500
WMU Doubleday-Hill Electric Co...Washington, D. C. 261
WNAC Shepard Stores .....Boston, Mass. 278
WNAD University of Oklahoma.....Norman, Okla. 360
WNAL R. J. Rockwell, 5019 Capitol Ave., Omaha, Nebr. 266
WNAN Syracuse Radio Telephone Co., 207 E. Jefferson St., Syracuse, N. Y. 286
WNAP Wittenberg College.....Springfield, Ohio 231
WNAQ Charleston Radio Electric Co...Charleston, S. C. 360
WNAR C. C. Rhodes.....Butler, Mo. 231
WNAS Texas Radio Corporation and Austin Statesman, Austin, Tex. 360
WNAT Lennig Brothers Co., 827 Spring Garden, Philadelphia, Pa. 360
WNAV Peoples Telephone & Telegraph Co., Knoxville, Tenn. 236
WNAW Peninsular Radio Club.....Fort Monroe, Va. 360
WNAX Dakota Rario Apparatus Co..Yankton, S. Dak. 244
WNJ Shotton Radio Mfg. Co.....Albany, N. Y. 360
WOAC Maus Radio Co., 404 N. Main St. Lima, Ohio 266
WOAD Friday Battery & Electric Corp., Signourney, Iowa 360
WOAE Midland College .....Fremont, Nebr. 360
WOAF Tyler Commercial College.....Tyler, Tex. 360
WOAG Apollo Theatre.....Belvidere, Ill. 273
WOAH Palmetto Radio Corporation, 267 King St., Charleston, S. C. 360
WOAI Southern Equipment Co.....San Antonio, Tex. 385
WOAL William E. Woods.....Webster Groves, Mo. 229
WOAN James D. Vaughn.....Lawrenceburg, Tenn. 360
WOAO Lyradion Mfg. Co.....Mishawaka, Ind. 360
WOAP Kalamazoo College.....Kalamazoo, Mich. 283
WOAR Henry P. Lundskow, 1066 Sheridan Road, Kenosha, Wis. 229
WOAT Boyd M. Hamp, 215 Market St., Wilmington, Del. 360
WOAV Pennsylvania National Guard, One Hundred and Twelfth Infantry .....Erie, Pa. 242
WOAW Woodmen of the World.....Omaha, Nebr. 526
WOAX Franklyn J. Wolff 600 Ingham Ave., Trenton, N. J. 240
WOC Palmer School of Chiropractic..Davenport, Iowa 484
WOI Iowa State College.....Ames, Iowa 360
WOK Pine Bluff Co.....Pine Bluff, Ark. 360
WOO John Wanamaker .....Philadelphia, Pa. 509
WOQ Western Radio Co. .....Kansas City, Mo. 360
WOR L. Bamberger & Co.....Newark, N. J. 405
WOS Missouri State Marketing Bureau, Jefferson City, Mo. 441

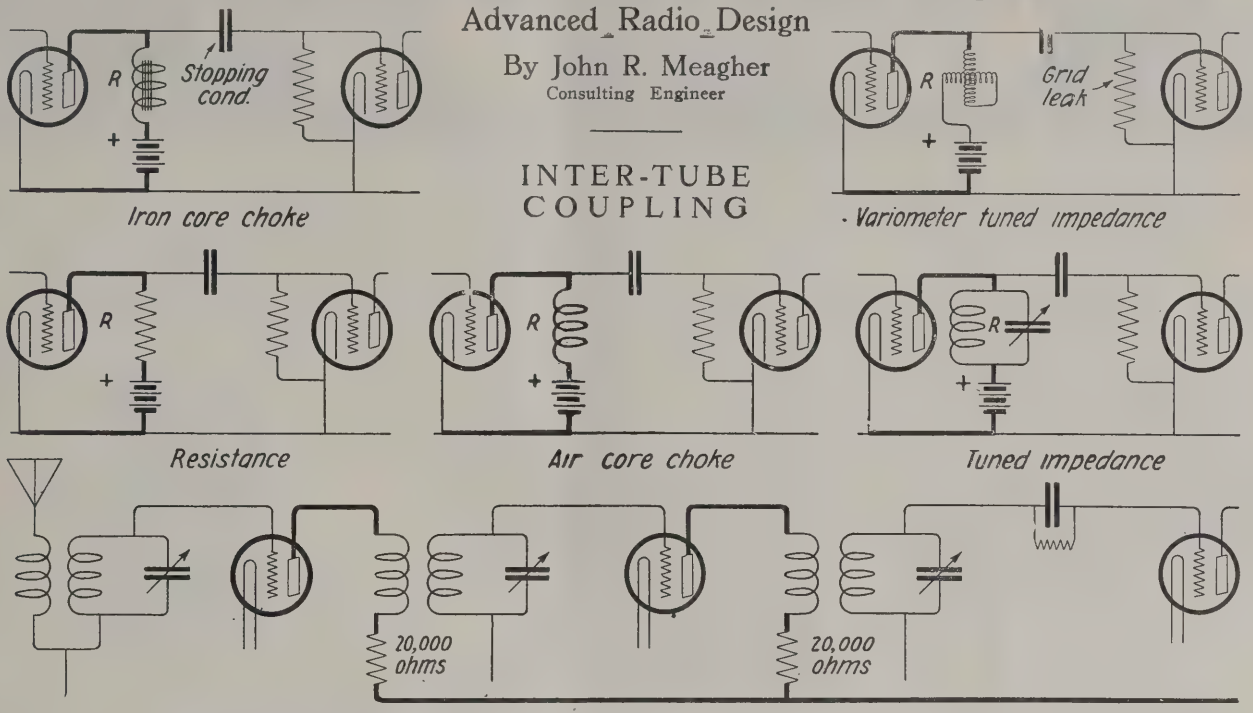
WPAB Pennsylvania State College, State College, Pa. 283
WPAC Donaldson Radio Co., 210 Tiger Bldg., Okmulgee, Okla. 360
WPAH Wisconsin Department of Markets, Waupaca, Wis. 360
WPAJ Doolittle Radio Corporation, 39 Center St., New Haven, Conn. 288
WPAK North Dakota Agricultural College, Agricultural College, N. Dak. 360
WPAL Avery & Loeb Electric Co., 114 N. Third St., Columbus, O. 286
WPAM Auerbach & Guettel, 709 Kansas Ave., Topeka, Kans. 360
WPAP Theodore D. Phillips, 222 Lexington Ave., Winchester, Ky. 360
WPAQ General Sales & Engineering Co..Frostburg, Md. 360
WPAT St. Patrick's Cathedral.....El Paso, Tex. 360
WPAU Concordia College .....Moorhead, Minn. 360
WPAZ John R. Koch.....Charleston, W. Va. 273
WPG Nushawg Poultry Farm....New Lebanon, Ohio 234
WQAA Horace A. Beale, Jr.....Parkesburg, Pa. 360
WQAC E. B. Gish..108 E. Eighth St., Amarillo, Tex. 360
WQAD Whitall Electric Co., 59 W. Maine St., Waterbury, Conn. 242
WQAE Moore Radio News Station..Springfield, Vt. 275
WQAF Sandusky Register .....Sandusky, Ohio 240
WQAH Brock-Anderson Electrical Engineering Co., Lexington, Ky. 254
WQAL Coles County Telephone & Telegraph Co., Mattoon, Ill. 258
WQAM Electrical Equipment Co.....Miami, Fla. 283
WQAN Scranton Times .....Scranton, Pa. 280
WQAO Calvary Baptist Church.....New York, N. Y. 360
WQAQ West Texas Radio Co. (Abilene Daily Reporter) Abilene, Tex. 360
WQAS Prince-Walter Co., 108 Merrimack St., Lowell, Mass. 266
WQAV Huntington & Guerry (Inc.)..Greenville, S. C. 258
WQAW Catholic University .....Washington, D. C. 236
WQAX Radio Equipment Co.....Peoria, Ill. 360
WRAA Rice Institute .....Houston, Tex. 360
WRAD Taylor Radio Shop .....Marion, Kans. 248
WRAF The Radio Club .....Laporte, Ind. 224
WRAH Stanley N. Read, 191 Alabama Ave., Providence, R. I. 231
WRAL Northern States Power Co., St. Croix Falls, Wis. 248
WRAM Lombard College .....Galesburg, Ill. 244
WRAN Black Hawk Electrical Co.....Waterloo, Iowa 236
WRAO St. Louis Radio Service Co., 5735 Bartmer Ave., St. Louis, Mo. 360
WRAV Antioch College .....Yellow Springs, Ohio 242
WRAW Avenue Radio Shop .....Reading, Pa. 238
WRAX Flexon's Garage .....Gloucester City, N. J. 268
WRAY Radio Sales Corporation, 110 Spruce St., Scranton, Pa. 280
WRAZ Radio Shop of Newark, 89 Lehigh Ave., Newark, N. J. 233
WRC Radio Corporation of America, Washington, D. C. 459
WRK Doron Bros. Electrical Co.....Hamilton, Ohio 360
WRL Union College .....Schenectady, N. Y. 360
WRM University of Illinois .....Urbana, Ill. 360
WRR City of Dallas, Police and Fire Signal Department ..... Dallas, Tex. 360
WRW Tarrytown Radio Research Laboratory, Tarrytown, N. Y. 273
WSAB Southeast Missouri State Teachers College, Cape Girardeau, Mo. 360
WSAC Clemson Agricultural College, Clemson College, S. C. 360
WSAD J. A. Foster Co., 69 Dorrance St., Providence, R. I. 261
WSAG Loren V. Davis and George Prestman, Jr., St. Petersburg, Fla. 244
WSAH A. G. Leonard, Jr., 4801 Woodlawn Ave., Chicago, Ill. 248
WSAI United States Playing Card Co., Cincinnati, Ohio 309
WSAJ Grove City College.....Grove City, Pa. 360
WSAL Franklin Electric Co.....Brookville, Ind. 246
WSAN Allentown Radio Club.....Allentown, Pa. 229
WSAR Doughty & Welch Electrical Co., Fall River, Mass. 254
WSAT Donohoo-Ware Hardware Co....Plainview, Tex. 268
WSAW John J. Long, Jr.....Canandaigua, N. Y. 275
WSAX Chicago Radio Laboratory.....Chicago, Ill. 268
WSAY Port Chester Chamber of Commerce, Port Chester, N. Y. 233
WSAZ Chase Electric Shop.....Pomeroy, Ohio 258
WSB Atlanta Journal .....Atlanta, Ga. 429
WSL J. & M. Electric Co., 26 Bank Place, Utica, N. Y. 273
WSY Alabama Power Co., Birmingham, Ala. 360
WTAB Fall River Daily Herald Publishing Co., Fall River, Mass. 248
WTAC Penn Traffic Co..Washington St., Johnstown, Pa. 360
WTAF Louis J. Gallo, 2222 Lapeyrouse St., New Orleans, La. 268
WTAG Kern Music Co., 84 Weybosset St., Providence, R. I. 258
WTAH Carmen Ferro .....Belvidere, Ill. 236
WTAJ The Radio Shop .....Portland, Me. 236
WTAL Toledo Radio & Electric Co.....Toledo, Ohio 252
WTAM Willard Storage Battery Co.....Cleveland, Ohio 390
WTAN Orndorff Radio Shop.....Matoon, Ill. 240
WTAP Cambridge Radio & Electric Co., Cambridge, Ill. 242
WTAQ S. H. Van Gorden & Son.....Osseo, Wis. 226
WTAR Reliance Electric Co.....Norfolk, Va. 280
WTAS Charles E. Erbstein, (near), R. F. D. No. 6, Box 75, Elgin, Ill. 286
WTAT Edison Electric Illuminating Co., (portable) 39 Boylston St., Boston, Mass. 244
WTAU Ruegg Battery & Electric Co..Tecumseh, Nebr. 360
WTAW Agricultural and Mechanical College of Texas, College Station, Tex. 280
WTAX Williams Hardware Co. .....Streator, Ill. 231
WTAY Iodar-Oak Leaves Broadcasting Station, Oak Park, Ill. 226
WTAZ Thomas J. McGuire.....Lambertville, N. J. 283
WTG Kansas State Agricultural College, Manhattan, Kans. 360
WWAB Hoenig, Swern & Co.....Trenton, N. J. 226
WWAC Sanger Bros. .....Waco, Tex. 360
WWAD Wright & Wright (Inc.), 2215 N. Broad St., Philadelphia, Pa. 360
WWAE Alamo Dance Hall.....Joliet, Ill. 227
WWAF Galvin Radio Supply Co., 521 Market St., Camden, N. J. 236
WWOA Michigan College of Mines, Houghton, Mich. 244
WWI Ford Motor Co.....Dearborn, Mich. 273
WWJ Detroit News .....Detroit, Mich. 517
WWL Loyola University .....New Orleans, La. 280

RADIO ENGINEERING

An Experimental and Home-Laboratory Course of Simple and Advanced Radio Design

By John R. Meagher
Consulting Engineer

INTER-TUBE COUPLING



Adding resistances in the plate circuits to increase the impedance

THE problem of coupling vacuum tubes for amplification of all frequencies employed in radio reception is one of importance; and it is a problem to the understanding of which the ambitious student may well direct this mental energy.

Let us first consider inter-tube coupling as a whole rather than the more usual way of dividing amplifiers into those types suited for high, intermediate or low frequencies.

We have one object: to make the plate current variations produce as large voltage variation on the grid of the next tube as possible; or better stated, to make the plate current variations produce maximum voltage variation between the plate and filament so that this voltage variation may be applied to the grid of the next tube. In doing this we are somewhat restricted by the necessity of applying the proper plate and grid voltages to the tubes so that they may operate properly.

To obtain the largest possible voltage variation between the plate and filament we may include in the plate circuit an impedance of a value at least equal to the plate-filament impedance. For small receiving tubes the plate-filament impedance for all except rather high frequencies is practically the same as the plate-filament direct current resistance which is found by the ratio of "B" battery voltage and plate current when the grid voltage is zero.

The external plate circuit impedance may be of any form which will permit a flow of direct current and also have a suitable high impedance for the frequency being amplified.

The external plate circuit impedance may be directly or indirectly coupled to the grid and filament of the next tube. If the impedance is an inductive one, it may be magnetically coupled to another coil connected to the grid and filament of the next tube—in which case we have "transformer" coupling. But whether it is an inductive impedance or not, it may be directly coupled to the grid and filament of the next tube: If common "A" and "B" batteries are used in this type of amplifier it is necessary to keep the plate voltage off the grids; this is usually done with a "stopping" condenser which insulates the grid from direct current, but has a value such as to readily pass alternating or pulsating current of the frequency to be amplified. (For one should remember that there is no alternating current in the plate circuit.) With such a "blocking" condenser, the grid would be "free" and might attain an excessively high negative charge—due to the negative space charge—which would reduce the plate current and "paralyze the tube." So a leak must be provided from the grid to the filament. Depending upon what point in the filament circuit the "grid leak" is connected to, the grid may be maintained at any desired value with respect to the negative terminal of the filament. This leak resistance must have a value high enough to prevent short-circuiting the grid; and a value low enough to permit the accumulated grid voltage to leak off during one wave train and thus prevent the tube from "paralyzing."

To summarize—1. *The external plate impedance* should at least equal and if possible exceed the internal plate-filament impedance at or over the band of frequencies being amplified. And the impedance should be capable of passing direct current.

2. *The "stopping" condenser,* if one is used, should be of such a value as to readily pass the frequency or band of frequencies being amplified, but should not pass direct current.

3. *The grid leak* should have a value sufficiently high to prevent short-circuiting the grid for the frequency being amplified, and a value low enough to permit proper and regular leaking off of the negative charge accumulated during each "wave train." The leak connection should be such as to enable maintenance of a proper grid voltage in order that the tube may be worked at a favorable point on the plate-grid characteristic curve.

The five figures represent several variations of "impedance" coupling; each has special qualifications and limitations, but essentially they are alike. Every transformer coupling is the same thing done differently.

We shall, in time, take up efficiency-requirements of these amplifiers, but at present we would like to point out how the above information might be applied to receivers that, while they operate well, could nevertheless be improved in design. These receivers have a few stages of transformer-coupled radio frequency amplification; the primaries of the transformers are composed of only a few turns; the secondaries are of such an inductance value as to permit a small variable condenser to tune them over the desired range. Now the impedance of the primaries is excessively low so that the plate voltage variations are not nearly as great as they might be. The purpose of such a few turns is to eliminate self-oscillation.

An easy method of "jacking up" the impedance would be to insert a (non-inductive, low inter-electrodic capacity) resistance of say 20,000 ohms in series with the primaries as shown in the diagram. This would reduce the plate voltage, but with the value suggested (20,000 omhs) there would be no necessity of increasing the "B" battery voltage of the radio frequency amplifiers. The rather high distributed capacity from the primaries to the filament would be in shunt to these resistances and would lower their effective impedance.

(*To be continued.*)

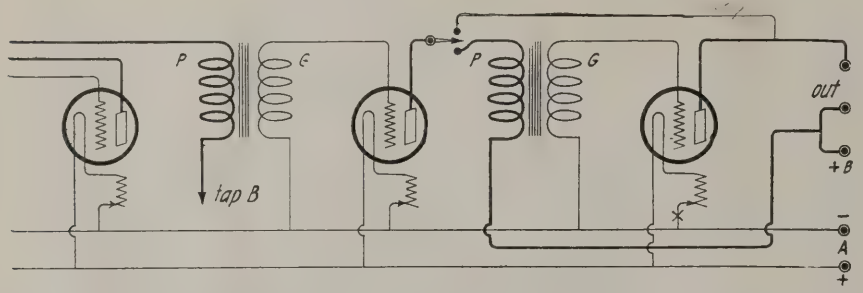
CONDUCTED BY R. A. BRADLEY

A self-addressed stamped envelope will insure a prompt reply to any queries on radio

Why Jacks?

"I am planning to build a receiver with two stages of audio frequency amplification; not being adept at soldering and realizing that connections to jacks require rather delicate workmanship, I am wondering if I could eliminate the jacks — using some simple method to change from step to step." Thus writes Mr. R. V. Marsten of San Diego, California.

The diagram in these columns shows an exceedingly simple, reliable and "fool-proof" switching arrangement to enable transfer of the headset from the first to second stage.



No provision for using the detector alone is shown as when an amplifier is available we very seldom wish to use less than one stage—even with a headset.

An extra "battery switch" may be placed at X in the diagram to break the filament circuit of the last tube when that is not in use. This is better than turning the rheostat to the "off" position.

Personally we do not like jacks and it is evident that many of the best manufacturers are of the same opinion, as numerous high grade receivers are now equipped with switches rather than jacks.

Avoid Hand Capacity Effects

Mr. Alfred Whitman of Iowa City, Iowa, asks how he can prevent the hand capacity effects especially troublesome in his receiver.

Very often, the average experimenter in connecting up a variable condenser to tune the secondary of a variocoupler or honeycomb coil unit, does not take into consideration this troublesome and annoying effect. In connecting a variable condenser in a circuit, always see that the rotary plates are connected either to the ground side of the circuit or the filament side, and the stationary plates to the grid side of the circuit. The reason for this is evident. Your hand as well as the rest of your body is at or near ground potential. That is, at zero voltage with respect to ground. Now if the rotary plates and the shaft of the condenser are connected to the filament or ground side of the circuit, there will be no difference of potential between your hand and the dial on the panel and consequently no condenser effect. A condenser which has the rotary plates grounded to the framework is a particularly advantageous instrument, as the greater part of the metal work in it is at ground potential, and, if connected up in accordance with these directions, it will be found that hand capacity effects are practically nil.

Adjustment of the Neutrodyne

Mr. Joseph Studer, Fort Wayne, Ind., says that in his neutrodyne receiver, if he takes either the second radio frequency tube or the detector tube out of the socket the music comes in just as loud as with them in.

This shows that one of the radio frequency tubes is rectifying, which in turn shows that the neutralizing condensers are improperly adjusted.

They may be adjusted as follows: Remove the first radio frequency tube from its socket and place a wad of paper around the two filament prongs, then replace the tube in the socket. The filament prongs are now not making contact with the springs in the socket and consequently the filament will not light. Tune in a signal as loud as possible, then adjust the first neutralizing condenser until you have decreased the signal strength as much as possible or eliminated it entirely. Now remove the wads of paper on the filament prongs and repeat the process with the second radio frequency tube. Your neutrodyne is now adjusted to its most sensitive condition. Note that this process will have to be repeated each time that new or different tubes are used.

C Battery Voltage

Mr. Julius Hengerer of Elkhart, Ind., wants to know the proper value of "C" battery to use with his audio frequency amplifier when applying 90 volts to the plates of the UV-199 tubes.

The correct value of the "C" battery in this instance is 4½ volts. It would not be advisable to exceed this "B" battery voltage of 90.

A Successful Crystal Set

Mr. Haseltine informs us that he has been getting remarkable results with his crystal set made up in accordance with the diagrams and sketches in the January issue of The Wireless Age. *His greatest DX has been Hastings, Nebr., approximately* 1,180 *miles from his home.*

Parts for the Uni-Control

Mr. Van Valkenburgh asks for the address of the Kardon Products Company, which is 101 *Varick Street, New York City.*

This company manufactures audio frequency transformers and the mounting shelf with the tube sockets already attached. He also states that he has been unable to obtain the Veldar variable condenser for use in the Uni-Control Receiver. Any variable condenser of good reliable manufacture with a means of vernier adjustment and with a capacity of .0005 mfd. will function satisfactorily in this set.

Shamrock Variometers for "The Wireless Age" March Set

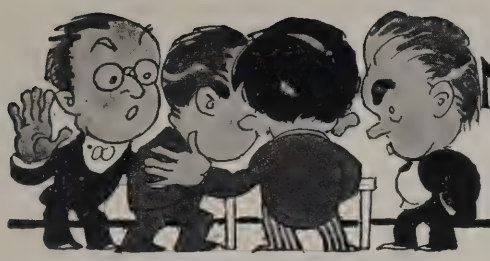
Mr. Miller of Glens Falls, N. Y., inquires whether or not Shamrock variometers can be used in the Special Three Tube set described in the March issue.

They can be used very satisfactorily. The Shamrock variometer comes provided with four Fahnestock clips fastened to the framework of the variometer. Two of these clips are the terminals of the stator and the two others are the terminals of the rotor. Before attempting to connect up these instruments in the set, be sure to run a strap between one rotor terminal and one stator terminal so that the two windings will be in series. Use the two remaining clips as the terminals of the completed variometer in connecting up the receiver.

Get Rid of Your Whistle

Mr. A. G. Hilson of Pasadena, Calif., wants to know how to cut out the high frequency whistle which he gets in the second stage of his two step a. f. amplifier.

There are a number of ways in which this can be done. The whistle can be eliminated by shunting the secondaries of each transformer with a 100,000-ohm grid leak of the sealed glass tube variety. Grounding the negative side of the "A" battery will accomplish it with about the same degree of effectiveness, and, of course, is easier to do. If neither of these have any effect, ground the cores and framework of the transformers. If the whistle is still in evidence, the transformers are mounted too close together and should be placed farther apart and at right angles to prevent interaction between their magnetic fields.

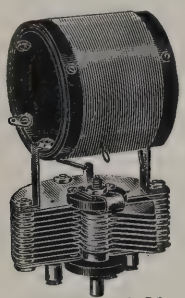


NEW APPLIANCES AND DEVICES

Condenser Tuned Radio Frequency Transformer

THE New York Coil Co. has brought out a condenser tuned radio-frequency transformer so designed that electrical losses, such as distributed capacity, have been reduced to the minimum.

The ratio between primary and secondary,



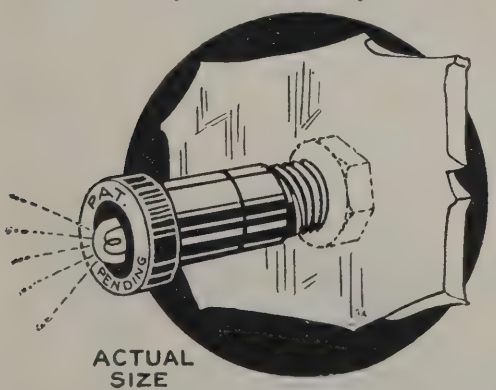
and the correct separation of same all represent the highest development, which together with the grade of material used—results in superior performance.

The transformer is rigidly secured to the New York Variable Condenser of 17 plates, which will tune sharply all wave lengths from 250 to 575 meters.

Kant-Blo Signal Protective Unit

THE Kanter Manufacturing Corporation, New York City, have perfected and are now marketing the Kant-Blo Signal, which is a protective unit for preventing the blowing out of radio tubes in receiving circuits.

This Kant-Blo Protective Unit is being made in two styles—one in the style of a B-



battery binding post and one in the style of a push-pull A-battery switch.

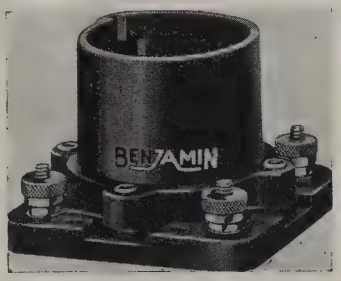
This protective unit takes the place of either a binding post or an A-battery switch that is now on any set, and one signal of either style will protect any number or type of receiving tubes from blowing out due to any short circuit that can develop.

The Kant-Blo eliminates the necessity and expense of using fuses for protection of the filaments; at the same time it provides a visible signal should a "short" develop.

New Vacuum Tube Socket

THE Benjamin Electric Mfg. Company, Chicago, is now producing a socket for radio vacuum tubes called the Cle-Ra-Tone.

The tube holding element of the socket floats on light springs which act as shock absorbers and neutralizes interfering vibrations which ordinarily would cause "tube noises." The general effect is clearer reproduction.



It is made in two sizes, one for standard base tubes and the other for UV-199 types.

A New Broadcast Set

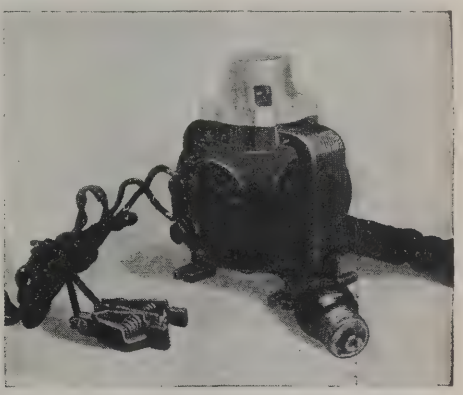
THE Bristol Co. of Waterbury, Conn., has brought out a new B.C.L. set using the Grimes Inverse Duplex Circuit. As shown by the cut, the equipment is mounted on a horizontal panel in a mahogany case with hinged lid, all connections to the set except phones being made through a panel board mounted at the back of the case. Ten plugs with four-foot cords are part of the equipment. The first two tubes are radio

frequency amplifiers, the third a detector, and then the first two tubes are used again in reverse order as reflexed audio amplifiers, the final tube being a power amplifier in the well known and really excellent Bristol circuit. The combination makes an unusual set.

The set has but one control, a vernier-equipped tuning knob. A voltmeter, showing the voltage at which the amplifier tubes are operating, is a valuable and rarely-seen part of the set.

"A" and "B" Battery Charger

THE Acme battery charger for radio "A" and "B" and also automobile batteries has recently been brought out on the market.



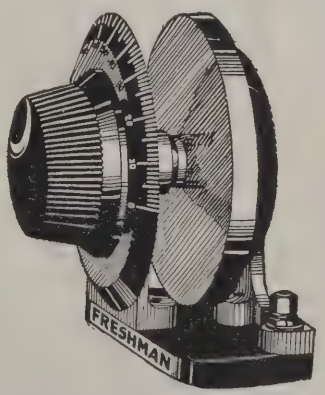
The capacities that these battery chargers are built in are 2 ampere and 5 ampere sizes to charge up to and including 36 "B" type cells.

The construction and design is very unique, and the operating characteristics are such that radio "A" batteries can be charged while the receiving set is in operation.

These battery chargers are being manufactured by The Acme Electric and Manufacturing Company, Cleveland, Ohio.

A Variable Condenser for Transmission or Reception

A VARIABLE condenser of entirely new construction has been developed by the Chas. Freshman Co., Inc., New York City. It has long been conceded by radio engineers that a variable condenser with mer-



cury plates and a mica dielectric would be the most efficient and compact condenser made. This can be readily understood, as the mercury plates make very intimate contact with the mica dielectric. The inventor has achieved this and has also evolved a construction wherein the plates vary in area.

The dielectric is a heavy piece of India ruby mica and the housing is made of Bakelite. The variation in capacity is accomplished by rotating the entire structure

(*Continued on page 62*)

INDUSTRIAL INKLINGS

A business-getter innovation of the Willard Storage Battery Co.

THE Radio Industries Corporation, New York, have been granted a patent on adjustable phones and loud speakers which covers any resilient member interposed between the diaphragm and the receiver case.

ROLLER-SMITH COMPANY, New York, offer in a pamphlet several direct current switchboard instruments which comprise ammeters, milli-ammeters, volt-meters, milli-volmeters, volt-ammeters. Their booklet contains charts which give the values per scale division. Such information is valuable when selecting instruments of this kind.

THE Federal Telephone and Telegraph Company, Buffalo, New York, have solved the constructional problems for the buyers of parts, by issuing an accurately marked template, showing how to correctly space the screw holes for mounting the instrument whether it be a variable condenser, variometer, variocoupler, rheostat, potentiometer or anti-capacity switch. A glance at the illustration will indicate the convenience of a template when marking and drilling holes in the panel. The builder has only to paste it on the spot where the holes are wanted and gently, but firmly, punch a sharp instrument through the paper into the panel, thus transferring the correct spacing from the paper template to the panel. The drill size for each hole is also furnished, so that when all holes are drilled, all you have to do is put the parts in position and tighten up the screws.

THE Rieger Research Corporation, manufacturers of Curkoids and Curkoid couplers have changed their location to 100 Charles Street, New York City, where they are occupying two floors. This change in location affords the corporation a considerable increase in manufacturing ability over that which they had in their old location.

ADAMS-MORGAN COMPANY have placed with every dealer appointed by Paragon distributors, an attractive counter display card to show Paragon connection. Every month they select their best piece of consumer advertising, have it reprinted to proper size to fit the card and send it to each dealer, so that he can keep his card up to date. In this way they tie together their consumer advertising with the dealer.

BRUNSWICK Electric and Radio Company, St. Louis, Mo., are distributing to their customers a small card which any radio dealer can have printed at a small cost. This card is made up in the form of an appreciation card which the radio listener may fill out and send to the broadcast station as his applause. These cards serve to promote the good-will of the dealer who issues them to his customers.

THE WINKLER-REICHMANN COMPANY, Chicago, Ill., have canvassed radio dealers with a snappy folder illustrating their Thorophone, attached to a questionnaire, well calculated to elicit some response.

PRESIDENT FREDERICK DIETRICH of C. Brandes, Inc., manufacturer of "Matched Tone" radio headsets and the Brandes "Table-Talker" has announced that the capitalization of the company has been increased from $500,000 to $1,000,000. The original capitalization was $5,000, and on March 3, 1923, less than a year ago, it was increased to the half-million mark.

Mr. Dietrich and Mr. C. E. Brigham, chief research engineer, sailed for Europe on March 8th, to visit the new plant of the Brandes, Ltd., in England.

Mr. Harry J. Walsh, who for the past year was assistant to Director Lane of the Electrical Industry's Joint Committee for Business Development, has been appointed publicity manager of C. Brandes, Inc.

LUDWIG-HOMMEL, Pittsburgh, Pa., have issued an encyclopedia of radio apparatus. This book contains their latest price list, particularly the receiving equipment section which will unquestionably be of paramount interest to all radio fans reading THE WIRELESS AGE. This encyclopedia-price list may be recommended unreservedly to any radio fan who is interested in the purchase of parts and equipment.

THE Progress Press of Union, S. C., have brought out a book, "Where I Go by Radio," for the B.C.L. which enables him to keep a complete record of his reception.

Spaces are provided for noting of dial setting, time, weather conditions, etc., and thus a really comprehensive record can be kept.

A Variable Condenser for Transmission or Reception

(*Continued from page* 61)

on two shafts which act as the terminals. The reservoir which contains the mercury is at the extreme lower portion when the condenser is set for zero capacity. As the condenser is rotated the mercury rides out of this reservoir into a thin circular chamber about one-sixteenth of an inch thick, forming a thin wall of mercury which increases in size, until the reservoir is at the top part of the casing. At this point maximum capacity is attained, due to the fact that you have a complete circular plate of mercury which is opposite to the circular plate of mercury on the other side of the mica dielectric.

The condensers give practically twice the capacity ever attained before in the same space where condensers of semi-circular plates are used.

In the official tests the condenser was found to withstand a voltage of 8,000 volts and to have a phase angle loss of less than one minute—the actual loss being too small to be measured accurately.

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

Why Big Cells Count in Radio "B" Batteries

THIS handsome metal case Eveready "B" Battery No. 766 costs only two-thirds more than the smallest Eveready "B" Battery, but it *contains seven times the electricity!* This makes the No. 766 over four times as economical as its baby brother. That is why most people buy it.

Its fifteen large cells give 22½ volts of strong, steady energy day after day. Cells that pour out power the moment you turn on your tubes. Cells that rest well when idle, renewing their vigor for your next demands.

No cells have a bluer-blooded ancestry than these. They are the product of thirty years of dry battery research and development of the world's foremost electro-chemical laboratories. We think that No. 766 is the handsomest battery ever made. But that is a matter of opinion. It is a matter of engineering record, however, that this great standard "B" Battery has proved itself as perfect in performance as we are convinced it is superfine in appearance.

The 45-volt Eveready No. 767 contains the same large powerful cells as the No. 766. For maximum "B" Battery economy, therefore, buy the 22½-volt Eveready No. 766 or the 45-volt Eveready No. 767, as you prefer. Here is the "B" Battery at its best.

Eveready "B" Battery No. 766
22½ volts. Six Fahnestock Spring Clip Terminals, giving variable voltage from 16½ to 22½ volts, in 1½-volt steps. Length, 6¾ in.; width, 4⅛ in.; height, 3 3/16 in. Weight, 5 lbs.

NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Company, Limited
Factory and Offices: Toronto, Ontario

If you have any radio battery problem, write to G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 198 Orton Street, Long Island City, N. Y. Informative and money-saving booklets on "A," "B" and "C" Batteries sent free on request.

Eveready 6-volt Storage Battery

No. 764 The Space Saver Vertical 22½-volt "B" Battery

Eveready Radio "A" Dry Cell Specially manufactured for use with dry cell tubes

No. 767 "B" Battery, 45 volts Variable taps Fahnestock Clips

No. 771 "C" Battery Clarifies tone and increases "B" Battery life

EVEREADY
Radio Batteries
—they last longer

Results of Amateur Trans-Atlantic Tests

IN the recent trans-Atlantic Amateur Tests made under the auspices of the American Radio Relay League the American operators report hearing thirty-seven European transmitters.

The American prize winners have been announced as follows:—

1ANA, R. B. Bourne, Chatham, Mass., Grand Prize.

Greatest Mileage For Any Single Reception

5AC, Norman S. Hurley, Mobile, Ala., 4,750 miles.

9DES, William Moore, Caney, Kan., 4,710 miles.

4BL, L. W. and T. E. Bryant, Lakeland, Fla., 4,540 miles.

9COL, Quentin Swigart, Galesburg, Ill., 4,310 miles.

9CD, Fred Marco, Chicago, Ill., 4,200 miles.

Greatest French Mileage For Any Single Night

1BDT, Sheldon S. Heap, Atlantic, Mass.

c1DD, W. Coates Borrett, Dartmouth, N. S.

3YO, Lafayette College Radio Club, Easton, Pa.

3II, Ed. Scattergood, Cynwyd, Pa.

2BIS, M. H. Hammerly, Bronxville, N. Y.

Greatest British Mileage For Any Single Night

c1AF, J. L. Fenderson, Jacquet River, N. B., Can.

Bronx Radio Club, Bronx, N. Y.

1GG, Robert H. Sproul, South Hamilton, Mass.

1BVL, Richard S. Briggs, Dorchester, Mass.

2AJF, J. VanRiper, Passaic, N. J.

Greatest Total French Mileage

1BCF, Levi G. Cushing, South Duxbury, Mass.

c1BQ, A. W. Greig, Halifax, N. S.

R. W. Woodward, Hartford, Conn.

3APV, Bernard J. Kroger, Washington, D. C.

1CKP, George H. Pinney, South Manchester, Conn.

Greatest Total British Mileage

A. A. Learned, Providence, R. I.

A. R. Tabbut, Bar Harbor, Me.

1BDU, Boardman H. Chace, Winthrop, Mass.

1AUC, Chester W. Sprague, Bar Harbor, Me.

1AUR, Harold G. Riley, Livermore Falls, Me.

Stations Worked and Heard

8DHQ—Chesaning, Mich.

(6aru), 6cdg, 6che, 6vf, 6brf, 6buy, 6cie, 6rn, 6awt, (6bpz), (6aoi), 6zp, 6azk, 6bzn, (6bcl), 6la, 6cmt, 6buj, (6ahp), 6gh, 6cei, 6bbw, 6cbw, 6zis, 6lv, 6fm, 6cmu, 6blh, 6buh, 6aoh, (6xad), 6cbb, 6aqq, 6nb, 6if, 6aao, 6eb, 6cgw.

7co, 7ahi, 7to, 7ih, 7lv, 7lb, 7abb, 7sy, (7bj), 7ajv, 7zl, 7af, 7ahu, 7vm, 7acx, 7ads, 7fn, 7ahv, 7fq.

8DCF—VINCENT FRENCH, 31 Kingsville Ave., Ashtabula, Ohio.

All cw—1aez, 1alj, 1all, 1aw, 1ayt, 1bwj, 1caz, 1cjr, 1ckp, 1fs, 2afp, 2axr, 2azy, 2bnc, 2ckl, 2cja, 2cor, 2cpd, 2ctu, 2cvj, 2ku, 3adb, 3aic, 3bhv, 3boi, 3bwt, 3bz, 3ccx, 3cel, 3hh, 3jx, 3qv, 3zm, 4mi, 4my, 4sh, 5alv, 5be, 5ek, 5jl, 5mo, 5vc, 5uk, 6akz, 6aur, 6brf, 6fp, 6li, 6rn, 6zh, 7co, 9aci, 9aic, 9apf, 9aza, 9baz, 9boz, 9caa, 9cvs, 9dlw, 9dtt, 9dun, 9dur, 9dyy, 9dyz, 9edb, 9eht, 9mc, 9vk, 9zy.

100 meters: 1dq, 3adb, 3bji, 4eh, 8aaf, 8aol, 8xbh, 9vm.

Spark: 4fg. Can. 2cg.

If ani of above want check on thr sigs just drop me a crd. Wud appreciate qsl's on mi sigs.

96-LJ—S. K. LEWER, 32 Gascony Avenue, West Hampstead, London N.W.6, England.

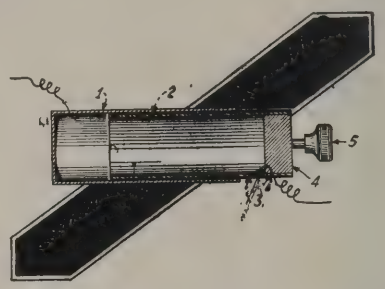
1ajp, 1ajt, 1al, 1all, 1alu, 1an, 1aol, 1ar, 1arc, 1ark, 1ary, 1as, 1atb, 1aur, 1bdi, 1bdt, 1bl, 1bq, 1bt, 1bwj, 1cmk, 1cmp, 1csw, 1dw, 1fe, 1fk, 1ii, 1jlf, 1kc, 1ma, 1mo, 1mv, 1my, 1ow, 1pa, 1rd, 1rj, 1sn, 1tx, 1vv, 1xam, 1xm, 1yb, 1yk, 1zp 1pc, 1bx, 1cj, 1bd, 1wl, 1ly, 1rk, 1tp, 1yd, 1bn, 1atm, 1bcf, 1bdu, 1bse, 1ccx, 1cmx, 1dq, 1gu, 1tw, 1cru, 1fm, 1xah, 1xj, 1ahf 1arq 1mm, 1xw, 1bbo, 1xak, 2adw, 2aed, 2ajd, 2ajp, 2al, 2ana, 2aur, 2ax, 2bar, 2bqh, 2ft fone, 2fx, 2gk, 2ht, 2io, 2iu, 2qe, 2tf, 2tu, 2ud, 2wa, 2wr, 2xap, 2ym, 2bsc, 2cla, 2br, 2fo, 2gx, 2it, 2cee, 2awl, 2el, 2bnu, 2cnk, 2azy, 2bn, 2awf, 2agb, 2csl, 3adb, 3aou, 3bd, 3bg, 3bgj, 3bkt, 3bq, 3bt, 3cbz, 3ck, 3cv, 3hg, 3wb, 3wf, 3ac, 3auw, 3co, 3te, 3xjp, 3bfq, 3pk, 3oe, 3ot, 3tu, 3qv, 3ud, 3cc, 3bl, 3yo, 4fs, 4ft, 4ht, 4rh, 4ri, 4tu, 4yx, 4zbq, 4gw, 4cl, 4ow, 4ar, 4ea, 4by, 4bz, 4hs, 4io, 5ab, 5aiu, 5cc, 5fg, 5ml, 6am, 6aos, 6awt, 6br, 6cmp, 6lj, 6xad, 6zz, 6bcr, 6bn, 7ac, 7af, 7bf, 7bj, 8adg, 8anm, 8ao, 8ary, 8asv, 8atd, 8awp, 8bd, 8bdi, 8bfm, 8blv, 8boa, 8btm, 8bw, 8ca, 8cb, 8cei, 8co, 8coj, 8com, 8cxy, 8cy, 8da, 8dg, 8dku, 8es, 8bk, 8ff, 8tc, 8tt, 8uf, 8vy, 8wz, 8xan, 8bbd, 8bcp, 8bqi, 8byq, 8dkd, 8ab, 8bh, 8ctp, 8ddc, 8hc, 8gz, 8rn, 8vz, 8vw, 8ekm, 8bdv, 8zu, 8aol, 6bbj, 9an, 9aon, 9aps, 9aur, 9bak, 9bed, 9bm, 9bof, 9bp, 9cmr, 9col, 9cra, 9cx, 9cy, 9dib, 9djx, 9dl, 9dop, 9drw, 9dwx, 9edm, 9efe, 9ta, 9tv, 9vc, 9zt, 9acq, 9biz, 9caf, 9eak, 9rm, 9aa, 9bl, 9ccm, 9cga, 9my, 9lm, 9ms, 9azx, 9fu, 9jy, 2bxw, 2by, 2ccx, 2cjx, 2cua, 2dac, 2dk, 2nj, 2br.

(All heard on detector and one-step.)

Simple Variable Condenser

A FRENCH amateur has told in the publication *"L'Antenne"* (The Antenna) how he built a small capacity variable condenser out of simple parts, for use in a resistance-coupled radio frequency amplifier.

The condenser uses the zinc can from a pocket flashlight battery for one plate. After the can has been cleaned and the interior scoured with emery paper a wire is soldered to it and it is ready. Next a small pill bottle is found of such a size that it will be a sliding fit within the can. Inside the bottle and cemented to its wall is coiled



some brass, tin or copper foil, likewise provided with a wire. A cork in the bottle, and a suitable insulating handle attached to the cork, and the job is done. This condenser, being of extremely small capacity, also has been found of value as a vernier in tuning.

Static

(*Continued from page* 23)

regions, and, probably elsewhere, and extending skyward, several hundred miles up.

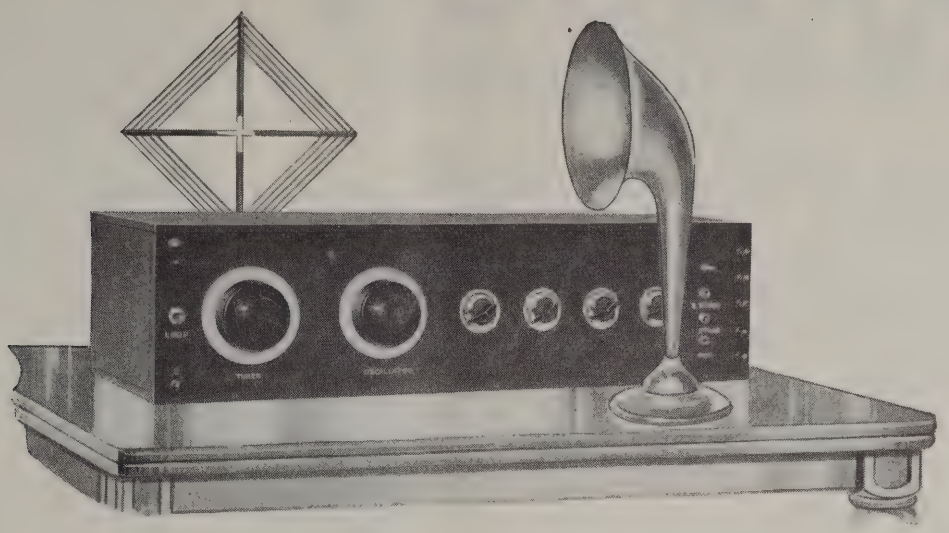
The phenomenon of the aurora borealis as seen in the Northern Hemisphere and the aurora australis, as seen in the Southern Hemisphere are mysteries as profound as the magnetic poles, and may not be explained until we can explain the magnetic poles and terrestrial magnetism.

In fact, the magnetic poles seem to be responsible for the northern and southern auroral displays. These displays usually occur in the regions of the magnetic poles and it appears that they occur simultaneously at both the north and the south magnetic poles.

The smaller magnetic poles and other unreported magnetic spots may be responsible for lesser auroral displays, the meaning of which are still beyond the understanding of mankind.

Brilliant auroral displays occur coincidently with violent sun spot eruptions. Simultaneously, heavy static discharges disrupt line communication and seriously interfere with radio transmission and reception. But such phenomena is recorded in lesser degree when the sun spots are less active.

Since radio appears to be the most sensitive medium through which static



The famous Ultradyne engineers recommend

ACCURATUNE

MICROMETER CONTROLS

On Ultradyne and Super-Heterodyne receivers, in which close tuning apparatus is employed, engineers recommend micrometer controls in preference to ordinary dials. R. E. Lacault, A. M. I. R. E., designer of the famous Ultradyne, recommends only the Accuratune Micrometer Tuning Control for use with this set.

The Accuratune is not a mere dial, but an actual micrometer tuning control, very responsive to the slightest touch of the micrometer knob, and ten times more efficient than any other tuning device. Stations that have never been heard before, are brought in clearly when tuned with the Accuratune.

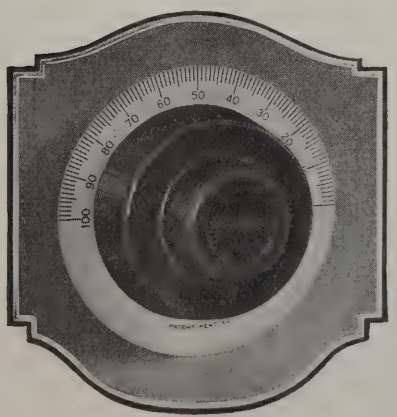
Designed for either coarse or precise tuning and to fit all standard condenser shafts. Guaranteed. Price $3.50. At your dealers, otherwise send purchase price and you will be supplied postpaid.

THE MYDAR RADIO COMPANY

9-A Campbell Street, Newark, N. J.

Radio, Ltd., Montreal, Canada

Canadian Representatives



EVERY ACCURATUNE PRODUCT IS A GOOD PRODUCT

PARAGON

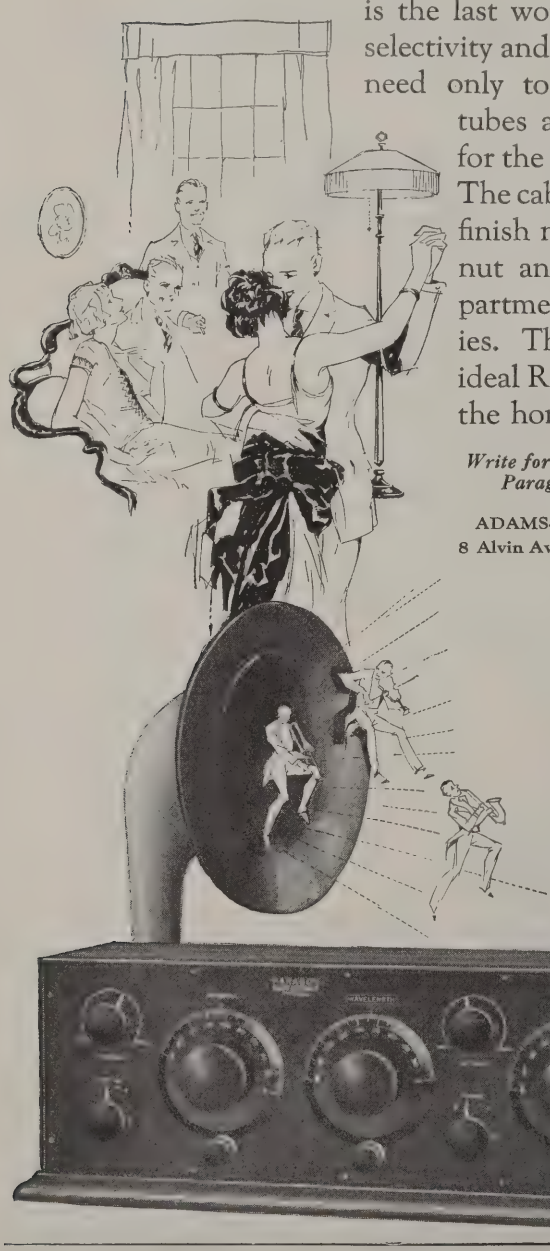
Reg. U.S. Pat. Off.

3-CIRCUIT RECEIVER

"HEAR THOSE SAXOPHONES!"

Every tone, every note clear and sweet. You can almost see the musicians swaying in time to the music. It's just as if the orchestra was right in the room with you. Why pay money to go dance when the best in the land can be had right at home over the radio?

The Paragon 3-Circuit Receiver here illustrated is the last word in sensitivity, selectivity and simplicity. You need only to switch on the tubes and set the dials for the station you want. The cabinet is of highest finish mahogany or walnut and includes compartment for dry batteries. The Paragon is the ideal Radio Receiver for the home.



Write for illustrated Bulletins of Paragon Radio Receivers

ADAMS-MORGAN COMPANY
8 Alvin Ave., Upper Montclair, N. J.

PARAGON MODEL
RB—2
PRICE $135.00

discharges may be observed, and consequently recorded, sun spot and auroral phenomena can be studied with a greater amount of accuracy through that agency.

How Radio Fans Can Help

Radio experimenters throughout the world can assist in establishing the following:

(1) Are auroral displays simultaneous occurrences at both the north magnetic poles and the south magnetic poles?

(2) Are auroral displays always attended by magnetic and electric disturbances; if so, to what extent, by actual registration of instruments; and to what extent geographically?

(3) Are auroral displays accompanied by "cracking" or "rustling" noises?

Radio broadcasting has made it possible to detect cosmic noises, unrelated to the world's machinery, which we may find to be related to the phenomena of auroral displays.

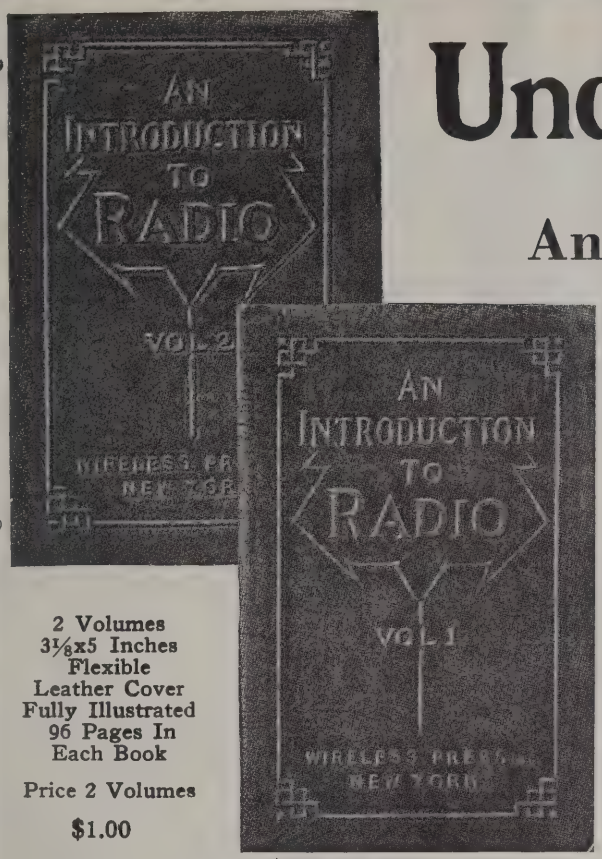
How? No one knows. It is another riddle—very important to the extension of radio activities that may easily be solved by the world's radio workers by little more than listening to these cosmic noises, reporting when possible their nature, duration and direction and the behavior of the compass to the Aerial League of America, who will sort these reports and transmit them to a body of the highest government and civilian authorities, who will arrange to have the information plotted and tabulated and—from the preponderance of evidence in favor of given deductions—may establish facts of great importance to the radio world.

By adding to their radio set the simplest equipment used for determining magnetic variations, the world's radio experimenters may in the course of a year supply data in their reports that will make it possible to establish the connection of the so-called "static" and "atmospheric" disturbances to the polar lights, the connection between polar lights and magnetic storms, the direction and geography of magnetic disturbances and other basic data.

Why man's total knowledge cannot yet explain these natural mysteries is a natural question.

The answer is that there are more branches of science involved and a larger territory than any individual or group of individuals has been able to master heretofore. I say heretofore, because I believe that the radio fans of the world can, combined, within two years, explain these phenomena.

As a result of earlier observations and tests, I suggested to the Aerial League of America a world-wide check-up, to last twelve months, the



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An Introduction to Radio

For the Whole Family
In Two Volumes—Handy Pocket Size

FREE TO YOU

We want you to know "THE WIRELESS AGE" (America's oldest radio magazine) and our laboratory tested text books. TO GET ACQUAINTED we offer you this fine little set of books ABSOLUTELY FREE with one year's subscription to "THE WIRELESS AGE." $2.50 A YEAR (Outside U. S., 50c extra). SAVE A DOLLAR.

ANSWERS YOUR QUESTIONS—Every novice in radio always asks the same questions: What is a radio wave? How is it made? How long does it take to get to me from the broadcasting station? Is there any difference between the dot and dash waves and the music waves? What is a condenser for? What is a variometer? What is the difference between a variocoupler and a loose coupler? How are the ear phones made? What does the crystal detector do? How does a vacuum tube work? What is the grid leak for? Is there any danger that my antenna will be struck by lightning? How can I tune my set to get the loudest signals? What is the difference between radio frequency and audio frequency? What is a potentiometer for and how does it differ from a rheostat? And scores of other questions. All are answered in this book.

Make no mistake. This is a non-technical book. All who can read English can understand it. Funny how hard it is for an expert to talk shop so everyone can understand—there are a number of good technical books, but this is the best book we have ever seen of the hardest kind to do well.

An introduction to Radio. That is just what it is. Mr. (Miss or Mrs.) Reader, we take great pleasure in introducing Radio. After a few hours you can meet the other members of the family and talk radio with them as you can't now.

If you were sailing for France you would study an elementary text book on the French language—here is your book for your trip to radio land, the most fascinating country ever discovered by modern science. Explore it knowingly, as thousands are now doing, with a receiving set and "An Introduction to Radio."

What's In Them?

VOLUME 1

An Introduction to Radio
Radio Telephony
The Various Instruments Used in Radio Transmitting and Receiving Outfits

VOLUME 2

Technical Terms Explained
How to Set up Receiving Outfits
Primer of the Vacuum Tube
How to Set up Radio Transmitters
International Morse Code and Conventional Signals

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I enclose $..... Enter my subscription to "The Wireless Age" for one year and send me free a set of "An Introduction to Radio." I also want.....extra sets for Christmas presents.

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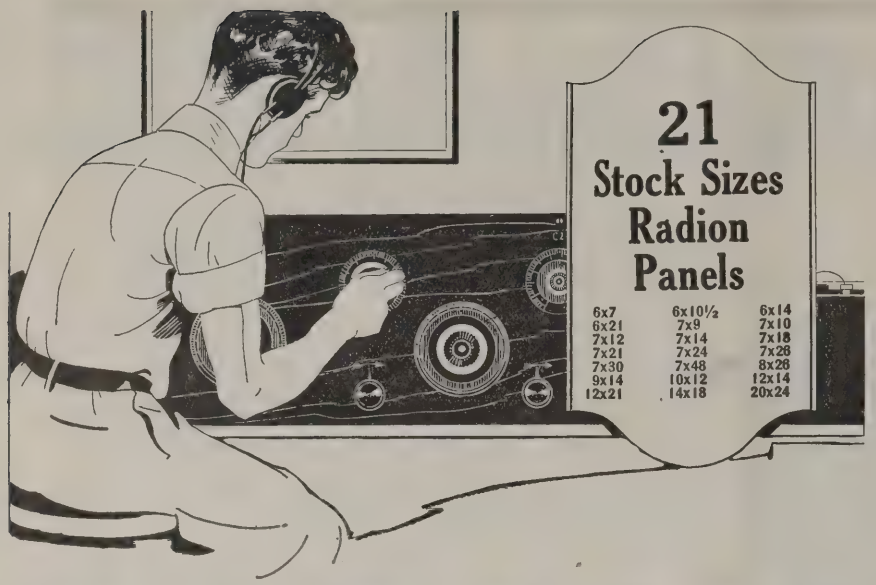
City .....

State .....

☐ New Subscriber ☐ I am now an AGE subscriber

A-4-24



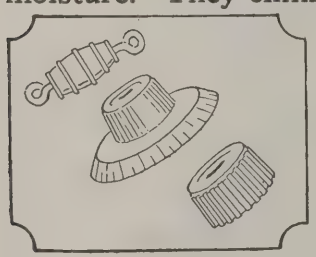
RADION

The Supreme Insulation

PANELS

Eliminate Short Circuits and Distortion

Any panel material which will absorb moisture is apt to cause short circuits and distortion. Radion Panels are impervious to moisture. They eliminate most of the leaks of radio frequency currents where other materials fail.



Your dealer carries a stock of Mahoganite or black Radion Panels, Dials and Knobs. Experienced amateurs and professionals, too, demand genuine RADION. Try it and you will notice the difference.

Look for this stamp on every genuine RADION Panel. Beware of substitution and imitation.

AMERICAN HARD RUBBER CO.

11 Mercer Street **New York**

length of time required to obtain data during the four seasons; and the world's radio fans—whoever has a receiving set—can participate by collecting data which may prove of great value to the art and science of radio and electric transmission. The League offers monthly prizes for the best monthly reports submitted.

The fact is that one of the most basic and frequent interferences in radio—as with wire service—is the aurora or polar lights. No remedy has been found because very little is known of the phenomena back of the aurora. The radio experimenter seems destined to solve that difficult problem. Whoever works out the solution will win world fame.

Further information regarding this contest should be addressed to The Aerial League of America, in care of The Wireless Age, 326 Broadway, New York City.

The Broadcast Riddle

(Continued from page 28)

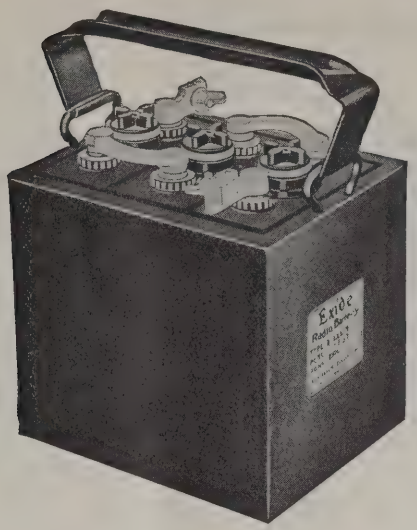
tainment to the station proper at Schenectady which in turn retransmits or broadcasts to the radio audience on a higher wave-length and greater power output.

When the cost of soliciting talent has been added to the budget for station operation, the unsound economics of broadcasting, as practiced today, is apparent. And obviously, getting what the public wants in choice program material becomes, daily, a more difficult problem as the excessive operating costs steadily rise.

The phenomenal growth of the new science that was destined to become the greatest instrument of publicity the world had ever known, or for that matter, had even conceived of in moments of wildest fancy, startled men of affairs in every phase of the modern industrial system. Publicity innovations, designed for engaging the public's attention increased by the hundredfold and the possibility of exhausting the field seemed to be ever more remote. Commercial enterprises rushed into the business of broadcasting. Manufacturers of radio equipment fairly sprang into being. Radio experts oozed from the appalling jam in ever increasing numbers. Editorials discussed radio. Newspaper and magazine stories toyed with radio. Radio became a universal topic. But none dared to analyze the situation.

The Kernel of the Thing

From the Olympian heights of wisdom a little group of men concerned with management alone, set



"A" Battery for six-volt tubes

When is a battery *cheap*?

A BATTERY that allows your soloist to be accompanied by a noise like a thunder storm is never a cheap battery; because it's certain that you will be dissatisfied and soon supplant it with a good battery.

Obviously, a battery that does not last long is not a cheap battery.

The battery that is really cheap is the one that gives perfect service and gives it a long time; one that does not have to be recharged too frequently —a silent, long-lasting battery, steady and dependable.

Because they give such good service and such long service, you will find Exide Radio Batteries cheap in the true sense of the word. They may cost you more than some to start with, but long life and freedom from repairs make the last cost low. And the added enjoyment you get from your set, through clarity and lack of needless bother, will be priceless.

In replacing a worn-out battery or when buying a new set, be good to yourself and get an Exide.

Complete line of Exides for Radio

There is a complete line of Exide Radio Batteries —batteries that give uniform filament current over a long period of discharge.

Apart from the 12-cell "B" battery there are three "A" batteries for whatever type tube you use. The Exide for 6-volt tubes gives full-powered, ungrudging service. It has extra-heavy plates and requires only occasional recharging. It comes in four sizes—of 25, 50, 100, and 150 ampere hours capacity.

The Exides for low-voltage tubes are midgets in size but giants in power. The 2-volt battery weighs only five pounds, has a single cell, and will heat the filament of WD-11 or other quarter-ampere tube for approximately 96 hours. The 4-volt "A" battery has 2 cells and will light the filament of UV-199 tube for 200 hours.

The dominant battery

On sea and on land the Exide plays an important role in the industrial life of the nation. In marine radio, Exide Batteries provide an indispensable store of emergency current. A majority of all government and commercial radio plants are equipped with Exides.

Exide Radio Batteries are sold by Radio Dealers and Exide Service Stations everywhere.

Ask your dealer for booklets describing in detail the complete line of Exide Radio Batteries. Or write direct to us.

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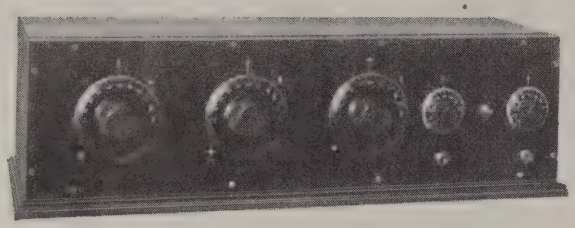
Pathé Type "P" Phusiformers



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Price $125.00
(Tubes, batteries extra)

A 5-tube de luxe set combining all the desirable features of the best receiving sets:

Does not oscillate.
Does not re-radiate.
Highly selective.
Sensitive to distant stations.
Free from hand capacity.
Simple to operate.

The Pathé "Minute Man" is housed in a genuine mahogany cabinet equipped with beautiful mahogany panel and gold engraved dials, making a handsome as well as efficient instrument.

FREE
A most complete and detailed instruction book showing how to construct a "Minute Man" Receiving Set will be sent you absolutely free of charge. Address Dept. 224.

Jobbers and Dealers
Write Dept. 224 for catalogs and prices of Pathé line.

PATHÉ PHONOGRAPH & RADIO CORP.,
20 GRAND AVENUE, BROOKLYN, NEW YORK

about to systematically determine just what broadcasting was. Having arrived at various conclusions, they compared notes. Having decided upon given conditions and approximate results, they forthwith turned their individual attentions to the solution of the broadcast situation according to the future problem of each.

They found that three factors constitute the primary motive for broadcasting. First, publicity. Secondly, as exemplified by the telephone company, the sale of broadcasting as another form of communication, and a definite industry. Thirdly, the manufacturer of radio equipment must encourage the demand for his product.

Individuals frequently find themselves handicapped in the progress of their particular endeavors because they need publicity that would be too costly through the customary channels, such as advertising and renting halls or financing public appearances on a tour. Broadcasting offers them a possible audience of well over 500,000 people, and moreover, an audience deliberately seeking entertainment. A lecturer can entertain with stories of travel, adventure, or discussion of topics concerning inventions and developments, instruction in finance, education, politics or industrial and social achievements and even deliver running accounts of news subjects. The musician can distribute samples of his accomplishment. The teacher can open new fields of culture and education. And the politician or public servant can obtain a hearing on projects of moment. All of which serves the public as well as the individuals seeking publicity. And such contact serves the dual purpose of developing latent talent and broadening the horizon for a public that eagerly seeks the world's knowledge just beyond the threshold.

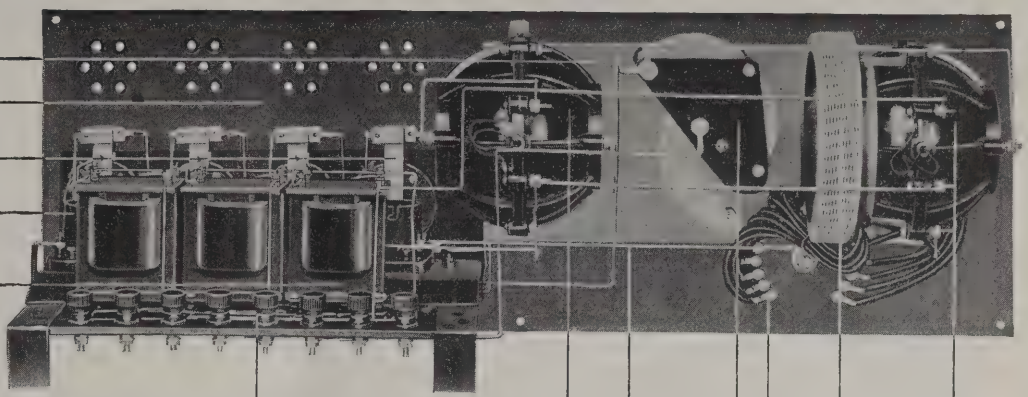
Organizations of the department store character employ broadcasting for publicity purposes. Unlike all their other forms of advertising, however, they do not expect, nor can they ascertain any direct return.

Newspapers have little else than the good will of subscribers that they may reasonably anticipate as a result of their adoption of broadcasting.

Manufacturers of products other than radio blandly charge broadcast expenditure to publicity costs and let the matter rest there.

Now let us consider the second factor. Communication as a marketable product is thoroughly established, as manifest in the telephone, cable and telegraph systems. And so, if broadcasting be considered as one form of communication, it may be reasonably assumed that everyone who wants to broadcast should expect to purchase this service. But the message to be

A NEW CIRCUIT DIAGRAM—READ IT!



It's Not the Face of the Watch, It's the Works that Tell the Story.

1. **Variable Condenser.** Contains forty-three plates of heavy aluminum with five plate vernier for fine tuning. Mounting plates of heavy Bakelite. Ends of rotor plates bolted, preventing bending or "shorting." Large bearings make smooth, easy operating.

2. **Inductance Coil.** Increases the wave range of the variocoupler to 3000 meters. Diamond wound for minimum distributed capacity. Tapped for selective tuning.

3. **Variocoupler.** Coupler shell and rotor built of solid Kellogg Bakelite, treated to avoid "distributed capacity." Many radio experts consider this the best coupler obtainable today.

4. **Variometer.** Rotor shaft accurately and permanently held in bearings. No sliding contacts. This variometer gives great added selectivity, more value.

5. **Transformers.** Designed to overcome defects of existing types and to furnish distortionless amplification of all audio frequencies. Sheet metal case heavily enameled. Primary and secondary binding posts most accessibly placed on the transformer, plainly marked.

6. **Rheostats.** Have strong, wide springs, grasping the rotor resistance on two sides with strong, positive contact. The control varies on the half turn of the coil wire on the rotor, giving vernier effect and enabling the operator to secure great selectivity, and freedom from noise and trouble.

7. **Tube Sockets.** All Bakelite. Bayonet slot reinforced with brass plate. Terminals plainly marked. Heavy springs inset into base, so they cannot touch mounting surface. With Kellogg tube sockets, there is no worrying about proper connection with your lamp terminals.

8. **Binding Post Assembly.** Symphony Binding Posts connect through separate openings in the rear of the set. Each of these openings have an insulating bushing. This does away with unsightly and unnecessary wiring connections on the front panel.

9. **Bakelite Panel.** This slender, strong, highly polished panel has the equipment located upon its face in the most advantageous positions. These mountings fit most accurately drilled openings and this face equipment is a model of proper radio assembly.

10. **Aluminum Shielding.** One who has not operated a radio set cannot appreciate the importance of careful shielding and grounding. Symphony shielding is pure aluminum and ample size, correctly drilled.

11. **Circuit.** The circuit of the Symphony is controlled by the apparatus above described, and mechanically wired as indicated, produces receiving of the highest order.

12. **Contact Points.** Heavy, silver plated for minimum resistance, an instance of the fine and all important attention to details that makes for successful radio receiving.

Mr. Dealer:
Write for our bulletins and discount sheet. The Symphony will increase your profits.

In addition to the important, accurate and successful units pictured above, there are also the other Kellogg radio parts to complete this most efficient circuit.

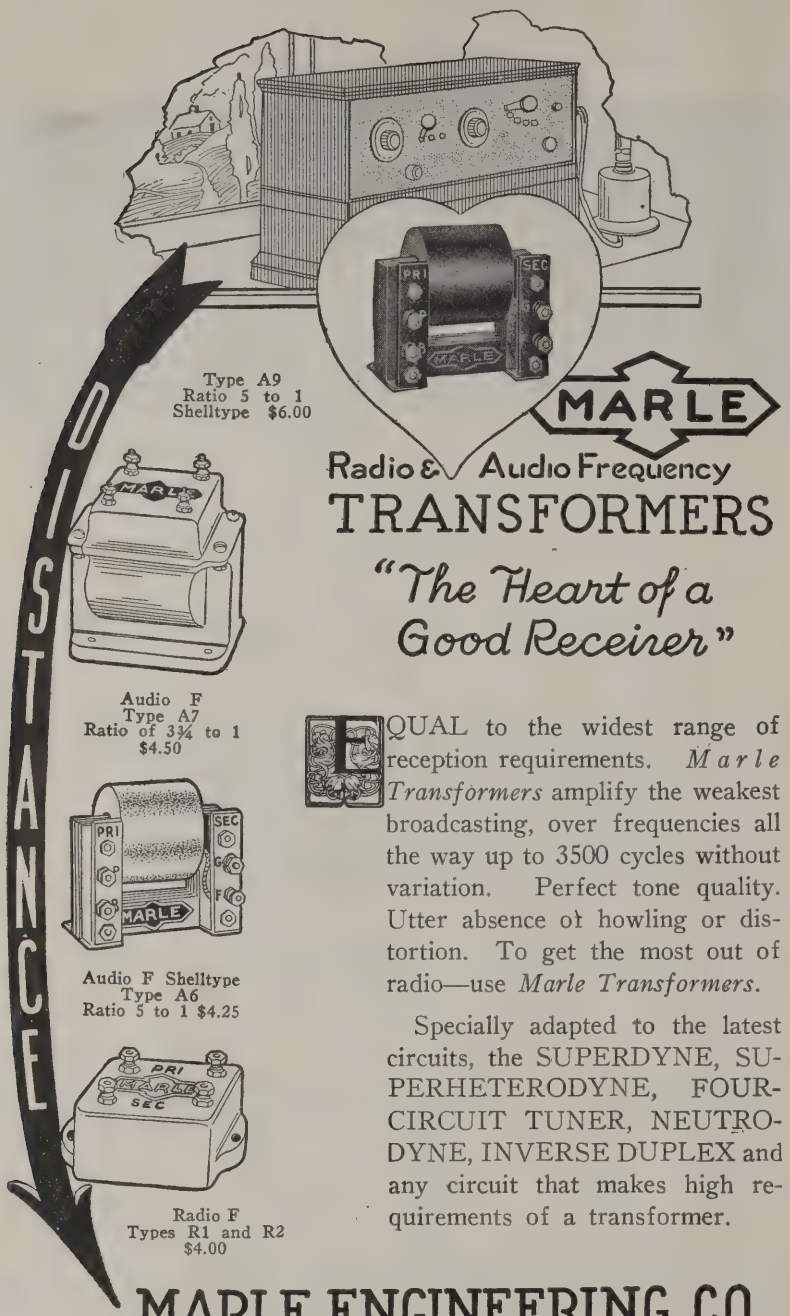
JONES RADIO COMPANY

1066 W. ADAMS STREET, CHICAGO, ILL.

The Symphony is manufactured under the U. S. Patent No. 1113149, Armstrong Regenerative Circuit

All parts used in the Symphony are built and guaranteed by the Kellogg Switchboard & Supply Company manufacturers for twenty-five years of complete telephone equipment

Mr. Radio Fan:
If your dealer does not carry Symphony receivers, send us his address. We will send you our illustrated Symphony catalog by return mail.

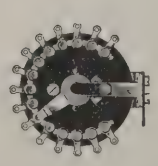


EQUAL to the widest range of reception requirements. *Marle Transformers* amplify the weakest broadcasting, over frequencies all the way up to 3500 cycles without variation. Perfect tone quality. Utter absence of howling or distortion. To get the most out of radio—use *Marle Transformers.*

Specially adapted to the latest circuits, the SUPERDYNE, SUPERHETERODYNE, FOUR-CIRCUIT TUNER, NEUTRODYNE, INVERSE DUPLEX and any circuit that makes high requirements of a transformer.

MARLE ENGINEERING CO.

Orange New Jersey



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DISTINCTIVE FEATURES

Positive Contact. Pigtail connection.
Solder terminal and contact one piece.
Westinghouse "Micarta" insulation.
Special numbered new type Knob Dial.
Position of contact always shown.
Eliminates contact points.
Only one hole to drill in panel.

(15 Points) **$2.00**

Send for Catalog

Carter Radio Co.
1802 REPUBLIC BUILDING
CHICAGO

delivered is intended for the general edification of an audience seeking entertainment and must consequently be dressed with the proper embellishments to render it acceptable. Having accomplished that end by rigid censorship the next step is merely a matter of fixing the charge in accordance with the fair balance between operating costs and service rendered.

Coming to the third factor, radio manufacturers try to encourage the sale of their products by operating broadcast stations. The broadcast stations now owned by radio manufacturers strive to serve the public according to the best interests of both and the rather particular enjoyment of the latter. They have no desire to market communication; they utilize to a great extent the desire of artists and others for publicity; their aim is to stimulate desire for their product.

An Experiment

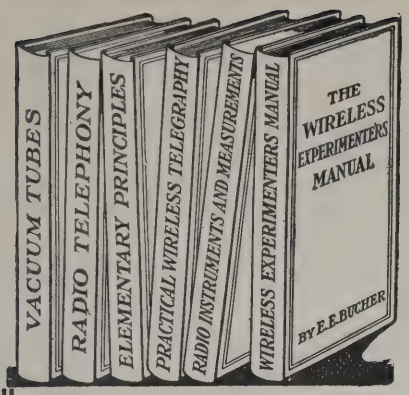
A dominant figure in broadcasting has advanced a theory and substantiates its practicability so convincingly that several of his fellow-executives expect to see the full realization of his plan in the near future. It seems to him that very likely there exists a group of people who desire grand opera avidly enough to welcome a subscription that would procure it. Collectively, the small individual fees could represent the purchasing power necessary to broadcast the best in opera. And likewise, symphony concerts, successful plays and famous artists could be procured for the asking.

And then, he claims, consolidation of broadcast centrals on a national scale would further enhance the real service of broadcasting. Subscription fees would automatically become smaller and a greater area gradually become cosmopolitan through intimate contact with the world at its best in culture and education.

But another well-posted radio executive maintains that broadcasting can surely be made commercially practicable without any means being found for collecting from the consumer. He insists that just as soon as the freedom and universality of radio is destroyed, and confined to only those who pay for the service, the fundamental of the whole situation is destroyed. This official believes that broadcasting as constituted today, is commercially sound, and will remain so in the future. He admits, however, that some selective and narrowcast methods may be found which will do no harm.

In a consideration of broadcasting and its development it is well to have a clear analysis as a starting point.

Broadcasting, as described, became a public service almost of its own ac-



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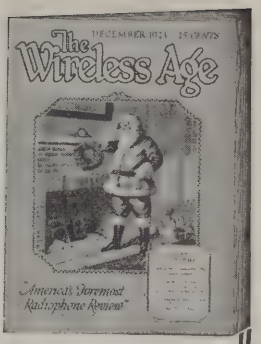

Pick out the books you want and Buy at these Rock Bottom Prices

Here is the greatest list of radio books ever presented. In this list are books that are known and used the world over.

Our stock room is overcrowded—we must reduce the weight per square foot. This gives you the chance to buy these books at a tremendous saving. Take advantage of this opportunity to complete your radio library.

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Wireless Experimenter's Manual	E. E. Bucher	2.25	35
How to Pass U. S. Government Wireless Exams.	E. E. Bucher	.75	10
How to Conduct a Radio Club	E. E. Bucher	.75	10
Alexanderson System	E. E. Bucher	1.25	18
Radio Telephony	A. N. Goldsmith	2.50	37
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BOOK	AUTHOR	Regular Price	Class No.
Technical Instruction for Wireless Telegraphists	Hawkshead and Dowsett	$3.50	55
Elgie's Weather Book	Elgie	2.00	20
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Magnetism for Home Study	Penrose	2.25	30
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Our unconditional guarantee of complete satisfaction is your assurance that FIL-KO-STAT will give you infinite adjustment of filament heat, noiseless tube operation and consequently more DX stations from *any* type of hook-up using *any* type of tube. *The Proof is up to you.*

Write for a free copy of our new booklet, "Improved Reception Through Scientific Tube Tuning." Address Dept. WA4

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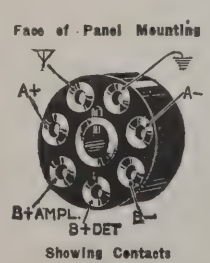

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Jones Multi-Plug and Cable

The Standard Radio Set Connector

Either panel or binding post mounting.
Does away with unsightly wires.
Leaves set free from live wires when not in use.
Several binding post ends can be connected to different sets—using one plug and cable connected to batteries, etc.
Ideal for dealers—and experimenters.
Prices, Multi-Plug and Cable Panel Mounting Type, $4.00. Binding Post type, complete, $5.00.
Write for illustrated folder of Howard B. Jones Radio Products

Howard B. Jones, 612 S. Canal St., Chicago, Ill.

cord. Program directors then had to determine just what the public wanted. Next, they determined what programs were made of. And then came the problem of just how to get the public what it wanted. That problem became an acute responsibility when the executives discovered that broadcasting involved tremendous costs that were mounting rapidly.

The same executives who have made the foregoing analysis are not agreed upon the issue of whether broadcasting rests at present on a sound economic basis. So the question, "Who will pay the broadcasting bill?" would still seem to be an open one.

* * *

There is now manifest a strong tendency to force this problem upon the public for solution. Already movements are well under way to organize the public into associations for such purpose. This is probably premature. Association — organization — at the present time would serve merely to substantiate the opinions of those who inspire the organization.

That problem must first be fairly presented, and then well understood. Radio fans must comprehend its proportional values. Then they must THINK . . . and DISCUSS . . . There is plenty of time.

But time—even time—advances.

[EDITOR'S NOTE: The writer of this article has alluded to the important part that letters from listeners have played in developing broadcasting. Letters can FURTHER contribute to its progress and stabilization.

THE WIRELESS AGE presents this problem and this opportunity to its readers.

You—Reader—are invited to contribute your opinion. YOUR opinion will be published in a later number as a symposium of what the public thinks about footing the broadcast bill.]

The Artist

(*Continued from page 33*)

tion of the total music of the world; they do not represent a monopoly or constitute a so-called "music trust" as those opposing us would have you believe; but I do claim that they create the essential music which the radio public desires to hear broadcasted.

Let us briefly summarize the arguments advanced by the broadcasters who decline to pay for the use of our works. (a) That they receive no compensation from the radio audience and therefore cannot afford to pay the copyright owner. (b) That recognition to the composer and author of music will necessitate payment to the musician, singer and lecturer who

now volunteer their service without compensation, an expense which it is claimed they cannot afford. (c) That broadcasting advertises music and is of material benefit to the writer who should look to other sources for his income.

The first point is not based upon the facts for though no payment is directly received from the beneficiaries of the service, payment is indirectly made in profits from the sale of radio apparatus, advertising, etc. The second contention is too absurd for any extended discussion. Upon what basis does the broadcaster expect anyone to give their service without compensation? Radio ought to pay everyone who renders it a service, most generously. It should secure the best talent available and pay it adequately. The radio audience should not be subjected to an inferior program of amateur artists and others seeking publicity. The third point, which is the one chiefly stressed, is without any merit whatsoever. In the first place we deny that broadcasting our music increases the sale of our product, and we reach this conclusion not by theory, but upon facts. Radio broadcasting seriously competes with the sale of sheet music, phonograph records and music rolls; it has diminished the royalties received by our members during the past six months upwards of fifty per cent., and to all appearances, promises to continue a further decrease.

In conclusion let it be said that in every civilized country of the world similar societies exist for the protection of composers and authors of music, and due recognition is given by payment for the privilege of performing copyrighted music. In this country, the organized effort and insistent desire for an equitable distribution of the rewards of industry, for a wider justice, for a more consistent righteousness in human affairs, is one of the most stimulating and hopeful signs of the present era. There ought to be a militant public demand for progress in this direction, but in the accomplishment of these ends there needs to be a better understanding in the name of the composers and authors for whom I speak.

The Broadcasters

(*Continued from page 32*)

tra simply to entertain its patrons, but frequently, because of the popularity already obtained by the orchestra through broadcasting and in other ways, it has a drawing power. There is a prominent Broadway café which occasionally employs the services of a well-known orchestra; when the or-

from New York to "Frisco"! By air-line, about 2600 miles apart! Yet, only a few "degrees" apart when you travel—

via

The GAROD Neutrodyne*

* *Licensed under Hazeltine Patent No. 1,450,080 and others*

Whether you "tune-in" from the home of WEAF or that of KHJ—you can always pick your own program with a Garod

A MUSICAL broadcast from New York, an organ recital from Philadelphia, a bed-time story from Pittsburgh, stock quotations from Chicago, the revels of the famous "Night-Hawks" of Kansas City, wholesome entertainment features from Omaha, from Dallas, from Detroit, and the throbbing dance music that has made Art Hickman famous up and down the West Coast—are all at your beck and call. With the Garod you pick the program you want—for after once getting a station you can always turn to it again—instantly—if it's on the air. Just write down the numbers on each of the three dials as you get a new station, and watch your list grow.

It is not unusual for an *inexperienced* operator to bring in stations a thousand miles away, or more, with the Garod. Our dealers are always glad to demonstrate. Listen-in today and become a Garod fan.

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120 Pacific Street, Newark, N. J.

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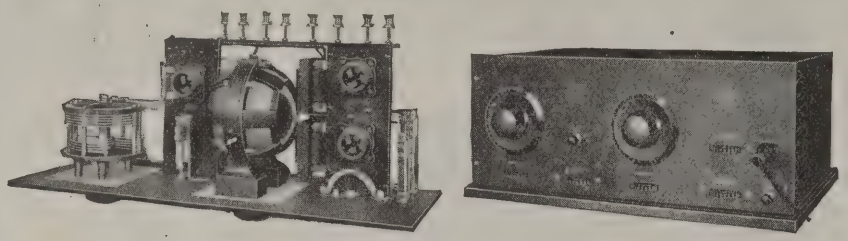

Grebe *and* Bakelite

The character of broadcast reception enjoyed by users of Grebe Radio Sets is due, in no small measure, to the extensive use of Bakelite.

Grebe standards of craftsmanship demand the best, and in selecting a dependable insulating material which would present a refined physical appearance, they chose Bakelite as the one material which would meet their requirements.

The excellence of Bakelite and the dependability of its qualities is indicated by the fact that a large majority of Radio Manufacturers choose Bakelite as insulation, and for improving and simplifying the design of their sets and parts.

Bakelite combines in ONE material the essential properties of many. It is highly dielectric and mechanically strong; it is unaffected by moisture, temperature or climatic changes; its color will not fade, even in strong sunlight; it will not warp, bloom or crack—but the most important property of "The Material of a Thousand Uses" in its relation to Radio is that of providing *permanently* effective insulation regardless of temperature or atmospheric conditions.

Write for a copy of our Radio Booklet A.

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Enclose 10c. to cover mailing cost and we will send you a large Radio Map which lists the call letters, wave length and location of every broadcasting station in the world. Address Map Department.

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149 East 86th Street **New York**

chestra plays there, more persons patronize the café, and naturally the more persons who go there, the more food and drink the café sells, with the increased attendant profit. This is a common sense viewpoint, and one that by the very nature of it, cannot be applied to broadcasting stations. Thus the analogy is not a fair one.

That broadcasting does popularize music, not only partially, but to a greater extent than by other methods, is evinced by the number of songs hardly heard of before broadcasting, but which now are sold by the millions of copies, and sung and played from one end of the country to the other.

Many songs have unquestionably been made by radio broadcasting. The American Society of Authors, Composers and Publishers offered $75,000 for a number that was popularized through broadcasting, indicating another attempt to corner everything worth while.

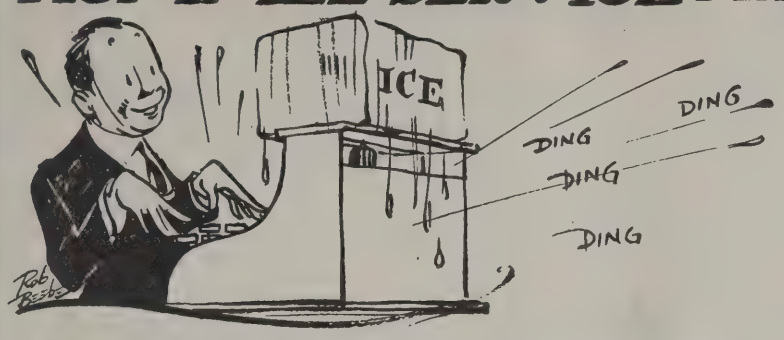
The only way any song can become popular and thus increase its commercial value, is by having a great number of persons hear it. Obviously they will not buy a copy of the sheet music, a phonograph record, or a music roll unless they like the composition, and in order to like it, they must hear it. A vocalist may reach, either through appearances on the stage, concert platform or auditorium, perchance in a lifetime, a few hundred thousand persons. Through the medium of broadcasting, millions hear a song in three minutes!

Performers are paid well for their time and talents, through broadcasting. Millions of persons who would probably never have heard of them had it not been for radio, attend the theaters where their names are advertised simply because their performances had been broadcast and found to be good. Thus the performers distribute samples of their talents to millions of potential buyers. Since the managements of theaters profit directly by this, salaries to performers are increased as the result. In fact, many actors who once had difficulty in securing engagements have found themselves in demand after broadcasting.

Broadcasting pays the actor well, and he knows it. Stars spend hundreds of thousands of dollars in other publicity stunts. And no advertising compares even remotely with broadcasting.

Authors, composers and performers profit through broadcasting; now how about the broadcasting stations? Do they operate at a loss, or do they derive a profit either directly, or indirectly from radio broadcasting? It is of course untenable to suppose that any good station costing thousands of dollars to install and from $25,000.00

HOMMEL SERVICE MAKES MORE PROFITS



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They wholesale exclusively,—they never compete with their dealers by retailing;—their discounts are fair and liberal;—they represent only the leading manufacturers of radio equipment;—they carry complete stocks of radio supplies insuring prompt deliveries and a dependable source of supply for the dealers.

Dealers who align themselves with HOMMEL service enjoy a steady repeat business—with satisfied customers—and that means more and better profits.

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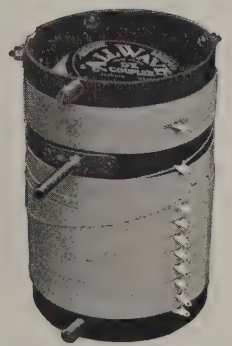
NON-RADIATING DX COUPLER



"ALL WAVE" Sr.
$7.00
150 to 3000 meters
Guaranteed
Wavelength

Set of six efficient hook-ups packed with every "All Wave" coupler or mailed on receipt of 10 cents in stamps to cover cost of mailing.

Combination Flat and Bank Wound

ALL the SELECTIVITY OF TUNED RADIO FREQUENCY at a SMALL FRACTION OF ITS COST. Like its companion, the 3000 meter Capitol "All Wave" Coupler, Sr., it may be used in a single circuit with the added feature that it may be used in a double or triple circuit.

Used in the "All Wave" triple circuit, the "All Wave" Jr. is guaranteed not to radiate and to bring in distant stations clear and loud on one tube. Log your stations and get them at the same setting every time. Only one dial to tune.

THE "SHEPCO" "ALL WAVE" JR.

Eliminates use of all variometers, vario couplers and loading coils. Permits building most efficient, sharp tuning, loud, long distance receiver at lowest cost.

Read These Results

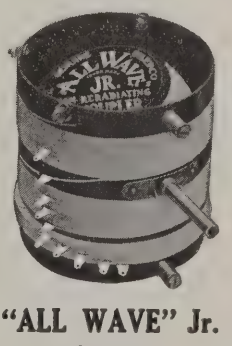
F. S. Thompson, DeKalb, Mo.
"Picked up London, England so it could be heard through two rooms."

J. W. Sutcliffe, Providence, R. I.
"Got KFI, Los Angeles, Cuba, Porto Rico and Nebraska. Convinced of quality of your product."

J. M. Blauvelt, Dallas, Texas
"For selectivity it is the goods. I can tune out and in any station at will."

Augustus H. Gill, Ph.D., Cambridge, Mass.
"Far superior to any combination of loose coupler, variometers or vario coupler."

SHEPARD-POTTER CO., Inc.
PLATTSBURGH, N. Y.



"ALL WAVE" Jr.
$6.00
150 to 1000 meters
Guaranteed
Wavelength

On sale at all dealers in standard radio parts or sent direct on receipt of price. ABSOLUTE MONEY BACK GUARANTEE.

BRISTOL SINGLE CONTROL RADIO RECEIVER

Most Simple to Operate

The set for those who want results with little effort. Anyone in the family can quickly learn to operate it because technicalities and guesswork are eliminated—One Control Dial does it all.

Does Not Interfere with Your Neighbor

Other close by reception is not disturbed when you tune in with this non-reradiating Receiving Set. It gives you a comfortable sensation of freedom to be able to change from one station to another knowing that you will not interfere with your neighbor's receiving.

Choice of Aerial or Loop

Where conditions make it difficult to install an outside aerial, as in congested sections of cities, good results can usually be had by using inside Loop. In fact, the directional feature of the Loop often brings in stations not possible with a stationary aerial.

Mounted in solid mahogany case with walnut finish, the Bristol Single Control Radio Receiver is handsome in appearance. The price is $190.00. Bulletin 1303-V describing this set will be mailed on request.

BRISTOL

TRADE MARK

AUDIOPHONE

REG. U. S. PAT. OFFICE

Loud Speaker

This is known everywhere as the Loud Speaker with the quality tone. Not only is the tone natural and without mechanical distortion, but is sufficiently big in volume to be easily heard in a large room or all through the house. Comes to you ready to use—no auxiliary batteries are required.

Made in three models:

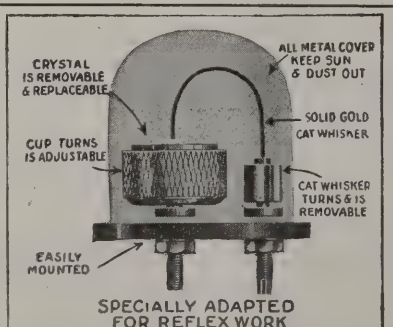
Audiophone Senior	Price $32.50
Audiophone Junior	Price 22.50
Baby Audiophone	Price 12.50

THE BRISTOL COMPANY, Waterbury, Conn.

The "LINCOLN" Enclosed Fixed Adjustable Detector

New. Wonderful. Fans wildly enthusiastic. Kills your reflex troubles. Brings in distant stations loud and clear. Price only $2.00. Absolutely guaranteed for one year. Ask your dealer or write—today. Jobbers and dealers: wire or write. Mention this ad. Address Dept. I.

Lincoln Mfg. Co. **Los Angeles, Calif.**


CRYSTAL IS REMOVABLE & REPLACEABLE
ALL METAL COVER KEEP SUN & DUST OUT
SOLID GOLD CAT WHISKER
CUP TURNS IS ADJUSTABLE
CAT WHISKER TURNS & IS REMOVABLE
EASILY MOUNTED
SPECIALLY ADAPTED FOR REFLEX WORK

to $200,000.00 a year to operate, should be a philanthropic institution. Nevertheless it is a fact that in dollars and cents, the overhead of running a station is a pure expense. Whatever returns the station may secure are mostly in good will and from an enlargement of their sphere of influence, two assets which are difficult to capitalize.

With broadcasting stations struggling under this load of expense, and with "listeners" having invested millions of dollars in radio apparatus, why should the radio public, the most vitally interested factor in this newest and greatest of sciences, permit any interference with its rights?

The Force of Public Opinion

Public opinion governs the world, and radio entertainment will be governed by public opinion. If broadcasters allow a get-rich-quick group to first corner the music market, and then dictate terms, it will be, as is usually the case, the public which will pay the bill.

Your Radio Storage Battery

(*Continued from page* 43)

Keep the Battery Clean

The battery should be kept clean and free from moisture. If moisture does gather on the top, this moisture, containing as it will a small amount of the electrolyte from the cell, forms a conducting path across the top of the battery from one terminal to the other and the result will be that there is a constant drain upon the battery.

Do not discharge the battery at greater than its normal discharge rate as this will overheat the battery and cause its plates to be ruined. This is something that will not happen unless a short circuit develops inside of the radio receiver as the present day tube with its low current consumption does not place a very great strain upon the battery. And though it is impossible to injure the battery by discharging it at a low current rate, remember that the storage battery, like many other pieces of apparatus, needs to be worked a certain amount to keep it in perfect condition.

How Long You Should Charge It

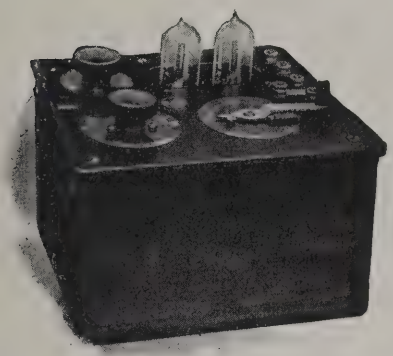
Do not charge it at too high a current rate for this will also overheat it and damage its plates. The small sized tube rectifier will charge a six-volt battery at approximately two and one half amperes which means that it would take twenty hours to put into it a charge of fifty ampere-hours. So the battery may be left on charge all night if it is partially discharged. It

CONTINENTAL

"New York's Leading Radio House"

THE SYMBOL OF SERVICE

Radiola III and III-A



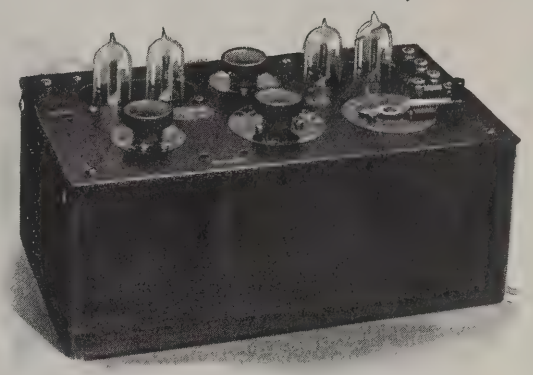
Radiola III

Radio Corporation receivers need no introductions.

The radio public always buy most generously and confidently where nationally advertised radio receivers are sold.

We have but one message for the radio dealer: We can supply you with the standard sets your customers want to buy.

Make it, "*A Radiola for Every Sale.*"



Radiola III-A

2071—Q

CONTINENTAL RADIO & ELECTRIC CORPN.

15 Warren Street **New York, U. S. A.**

Price

$7.00

(2200 OHMS)

Federal Standard RADIO Products

PERFORMANCE

THE performance of a radio receiving set, like any other mechanical piece is only as good as its weakest part.

The Federal Telephone and Telegraph Company manufacture 130 different radio parts, which carry the Federal guarantee of perfection, due to more than 25 years' research by experts in the radio field.

To insure 100% performance specify Federal when purchasing a complete radio or parts.

All reliable dealers carry Federal Standard Radio Products

Federal Telephone & Telegraph Company

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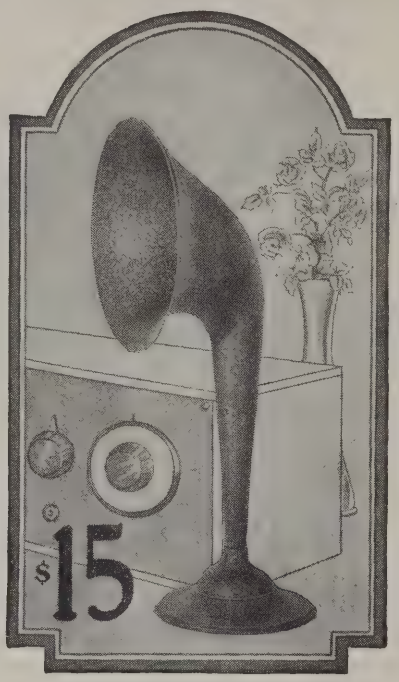
Perfectone

TRADE MARK

FAMOUS
for performance

ATTRACTIVE
in appearance

POPULAR
in price



Phonograph Attachment
$8.75

It is refreshing to hear a Perfectone as its tone convinces you of its superiority.

Before you purchase a loud speaker or phonograph attachment at any price, see and hear the Perfectone.

At your dealers, otherwise send purchase price and we will supply you postpaid.

PERFECTONE RADIO CORPORATION
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BROADCASTING IS THE UNIVERSAL STAGE—YOUR ARM CHAIR A BOX SEAT

BURGESS
RADIO BATTERIES

"A Laboratory Product"

Madison, Wisconsin

2 Transformers for the price of 1

NEUTRODYNE

No Distortion
Greater Volume
Half-Price

For $6 we will send postpaid TWO of the famous Globe Audio Transformers made especially for Neutrodyne sets.

MONEY BACK GUARANTEE
If you are not fully satisfied with the transformers, return them within 5 days and your money will be refunded.

COYNE RADIO SERVICE
Suite 603
507 Fifth Avenue, New York City

is perfectly safe to do this as the author has made actual tests with the thermometer to see how hot the inside of the case will get after a run of about twelve hours and it was found that, with the case entirely closed up, at the end of a half-hour the temperature had risen to one hundred degrees Fahrenheit and it remained there during the entire charging process.

Beware of Explosion

Do not use matches to look inside of the cells to see if the solution is above the top of the plates for during the charging process hydrogen gas is generated and this when combined with air will result in an explosion which will spray the electrolyte over the surroundings and if one were looking into the battery he would most likely have his eyes burned seriously and might even be permanently blinded. This precaution is not included here to deter anyone from using the storage battery, but merely to emphasize the fact that as an explosive it ranks with gasoline only differing in that it is only present during charging and of course, being only present in small amounts, will not cause fires, but will spray the acid around. But it is something which should be guarded against.

The final precaution to be observed is to always keep the level of the solution inside of the battery from one-half to one inch above the tops of the plates of the cell. This will be done by the addition of pure water only, and this does not necessarily mean drinking water for the storage battery demands a water which is free from mineral matter such as is present in most drinking water. In some cities in the United States such as New York City for example, the use of the ordinary city supply is approved for use by some storage battery manufacturers for use in their storage cell, but unless information has been procured from the maker of your particular battery that you may use the water of your particular location in his battery you should use nothing but distilled water which has been obtained from a battery repairman.

If these precautions and any others which are supplied with your battery are faithfully carried out it will be found that the battery will last longer and will give much greater satisfaction in operation than would otherwise be possible. Last but not least, if any trouble should occur which you do not understand, write to the maker of your battery or take it to a reliable repairman who is acting as a service station for that make of battery and be governed by his suggestions.

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We sell to no others.

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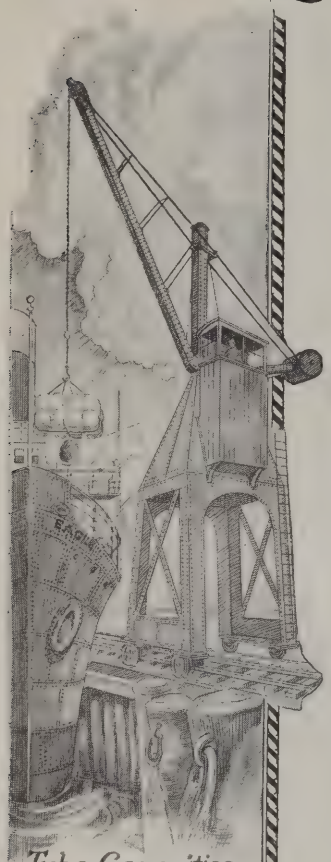
Eagle Neutrodyne Balanced! RADIO RECEIVER



Tube Capacities BALANCED

Just as the Electric Crane Arm is Balanced

THE sincerest praise of all—that of the user—is time and time again accorded to the EAGLE—greatest of neutrodyne receivers. All the uttermost resources of radio are yours to command with the remarkable **Eagle Neutrodyne Receiver.** Far-distant stations are brought in clear and loud, as easily as a phonograph is operated. Tube capacities are balanced just as the power crane is balanced by its counterweight. Each Eagle Receiver is individually balanced and tested by a prominent radio expert. Backed by an excellent reputation. Guaranteed without reservation.

***

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patent No. 1,450,080, dated March 27th, 1923, and other patents pending.

Write for Illustrated Leaflet

WE SOAR ABOVE
EAGLE RADIO COMPANY
NEWARK NEW JERSEY

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RADIO PIN-MAP

of United States, Canada and West Indies with indexed booklet broadcasting guide.

SPOT STATIONS YOU HAVE HEARD WITH COLORED MAP-PINS.

Map size, 22 x 14 in., mounted on map-pin board. Shows all broadcasting cities, distance scale, relay and time divisions. Guide gives all call signals, locations, stations, wave lengths, etc. Price complete, 85c. Map-pins, 10c per doz. Any color. Above booklet with folded paper map, 35c. At your dealer or direct.

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Add to Radio Satisfaction by Keeping Correct Radio Records

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The Easily Kept Record System. Every Line Complete Record When, Where, How and What you "Tuned In." Book also contains Accurate List Radio Stations, and other useful features.

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Get from your News-stand, Book or Radio Dealer or order today direct.

Radio Dept., Progress Press
Box A, Union, S. C., U. S. A.

Tubes That Play 'Possum

(*Continued from page* 49)

How to Revive an Apparently Used-up Tube

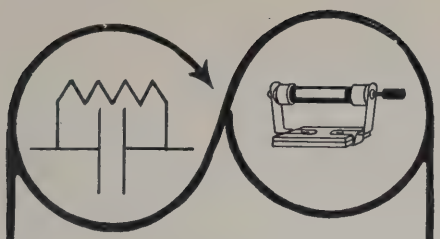
A very peculiar action often occurs with these tubes. It sometimes happens that the electron emission drops to low values after being used for only a short period. This is frequently due to the fact that a high voltage was accidentally applied to the filament, as a result of which the surface thorium emits all of its electrons. If a very high voltage is applied to the tube for a very long time it is possible that the tube will lose all of its electron emission, since the filament may be heated so much that all of the thorium emits all of its electrons. But if this high voltage has been applied for a short time only it is possible to bring back the emission as follows: Simply apply normal filament voltage to the filament, without applying plate battery. This will have the effect of reactivating the thorium which is on the inside of the filament wire, bringing it out on the surface where it is of use.

The New Tubes Better Amplifiers

These thoriated tubes have other advantages over the old tungstens, chief of which are higher efficiency, greater amplification, and more output. The filament efficiency is measured by the number of electrons emitted for unit power consumed in the filament. The emission of thorium is far greater than that of tungsten, and since the current consumption in the thoriated tubes is also smaller, it follows that the emission efficiency of a thoriated tube is much greater than that of a tungsten tube. Due to the difference in the two types of filaments it is possible to design the other parts of the tube so that higher amplification constant are obtainable. Thus the UV-201A has an amplification constant of about 8 as against that of about 6 for the old tungsten UV-201 tube. Even the peanut tubes operating on dry cells have amplification constants equal to that of the large UV-201.

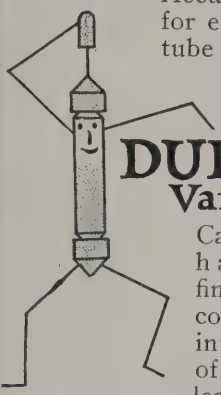
The Silvering Maintains the Vacuum

Questions are sometimes asked about the silvery appearance of these new thoriated tubes. This silver coat has nothing to do really with the performance of the tube. It is obtained during the process of evacuating the tube. During the period of exhausting the tube of gas, and especially toward the end of the evacuating process a chemical is flashed inside of the tube which takes up the small residual gas and is deposited on the wall of the tube as a silvery deposit. This chemical is called a "getter"—in view of the fact that it "gets" the gas. It is active through-



Only Variable Grid Leak to fit all sets

Accurate control for every detector tube in the land now possible with



DURHAM Variables

Cartridge style, having one-finger plunger control, snaps into the place of present fixed leak. No panel-drilling or wire change.

No. 101 for storage batt. tubes
No. 201-A for dry-cell tubes

Typical sets improved with DURHAM VARIABLE GRID LEAK

Radiolas	Mu-Rad
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and all Neutrodynes

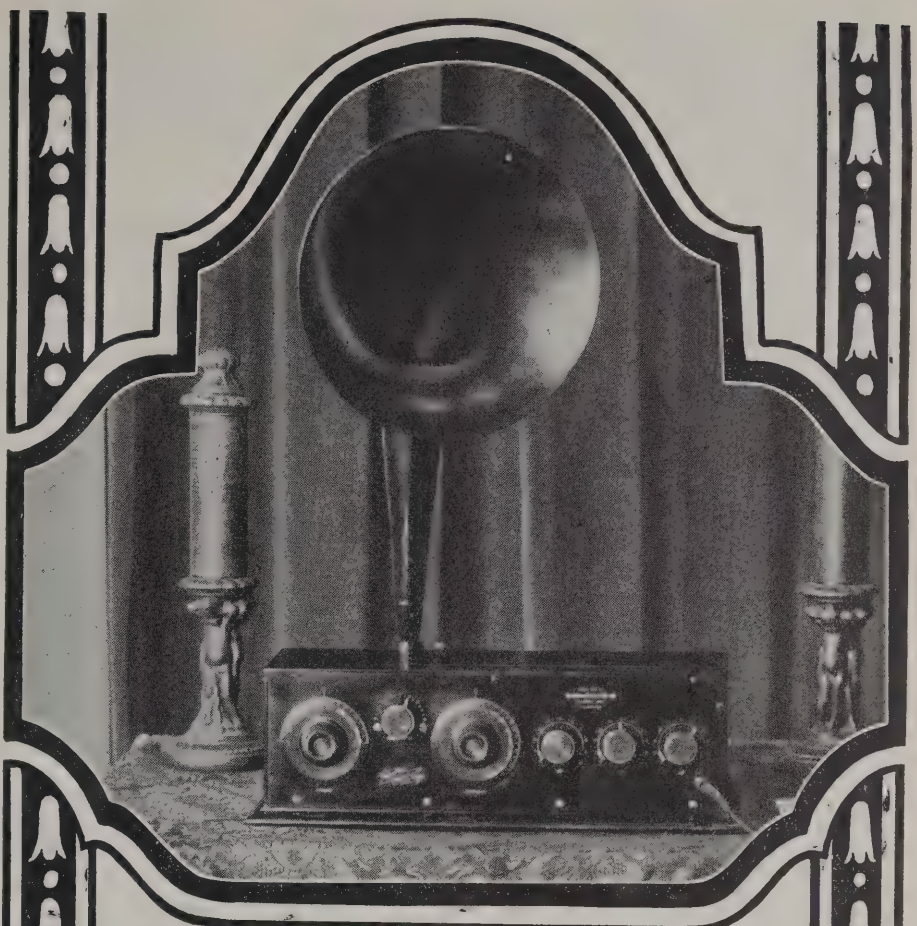
Only 75c. at dealers; or 80c. postpaid

Free, folder "G" gives details. Get yours from dealer or write

Satisfaction Guaranteed

DURHAM & CO., Inc.
1936 Market St., Philadelphia

Dealers: Every detector tube needs a DURHAM—the easiest to install, use—and sell.



Radiodyne

NO LOOPS **"The Voice of the Nation"** **NO ANTENNA**

The air is your theatre, college, church, and newspaper if you own a Radiodyne. New York, Cuba, San Francisco and Honolulu can be picked up clear and distinct without interference from nearby stations.

The RADIODYNE is ready for operation by simply grounding to a water pipe or radiator, and throwing a few feet of wire on the floor.

Uses any standard tubes—dry cell or storage battery. Extremely selective. Simple to operate—***Only two controls***—you can tune in on any program you select—any wavelength from 200 to 700 meters. For use in apartments, boats, automobiles, railroad trains, etc., the RADIODYNE is enjoyable where other receiving sets would not be practical.

Price $150.00

Write for illustrated folder which describes the RADIODYNE in detail. Every radio fan will be interested in this new type (antennaless) receiving set.

WESTERN COIL & ELECTRICAL CO.
316 5th St. **Racine, Wisconsin**

RUSONITE RADIO CRYSTAL

Entire Surface Sensitive
The Recognized Standard Crystal Rectifier
Used all Over The World
Hundreds of Thousands of Satisfied Users. Rusonite Has Revolutionized Crystal Radio Reception.
"THE PERFECT SYNTHETIC CRYSTAL"
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Supersensitive; will not oxidize
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of the
REV. S. PARKES CADMAN
are now being reprinted
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CHRISTIAN HERALD

As You Gaze at the Stars—
The gentle calm of a bright starry night fills us with mystery. Little did we dream a while back that today, far and wide in the unknown, thousands of voices, hurled by electrical energy, are rushing at unheard of speed through space to all points of the compass.
A person here, a group there—in fact, in a million or more homes people are anxiously tuning in on their radio's groping in the air, hoping to catch the sound of a far away station. Scarcely a sound, a slight turn, a faint noise, another adjustment and then clear and clearer comes voices, a quartet is singing; so clear and distinct come the soft gentle melody that the listeners close their eyes, the singers seem to be in the very room with them.
If you desire clearer reception, greater volume and the elimination of howling and distortions, install Jefferson transformers in your set.
There's a Jefferson Transformer for every circuit.
Write for amplification data and interesting descriptive literature.
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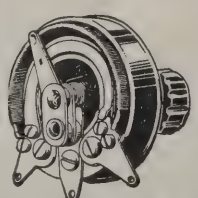

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DOUBLE DISCONNECT
"POTENTIOMETER"
(Trade Mark)

One outstanding feature is the Double circuit breaker, which automatically disconnects A and B battery circuits, thus positively eliminating A battery drain (as heretofore present in all Potentiometers) and at the same time absolutely preventing accidental burning out of tubes with B battery voltage.

Genuine Nichrome wire wound. Bakelite base. Silver etched dial. Price, 250 ohm, $2.50; 500 ohm, $3.00.

Our Free Bulletin No. 92 gives complete list of Premier Radio parts priced right. Ask your dealer.

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CATALOG L-25 148 PAGES FREE!
Latest Reflex Neutrodyne and Super-Heterodyne Circuits. 40 Diagrams, latest Hook-ups. Largest Complete Stock.
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SPECIAL American Reflex Super-Sensitive Crystal, 35c ea. Hot as Hot, Every Spot. Hear stations clearly.
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out the life of the tube, and should any gas develop during the life of the tube, the "getter" absorbs it. Thus the vacuum of these new tubes is never destroyed.

Inasmuch as these tubes are relatively new it is hoped that the data here presented may be of value to those who have begun to use them. A big stride forward has been made in reducing the cost of operation on receiving tubes, and amateurs who are interested in transmitting are beginning to wonder whether such improvements cannot likewise be made on the transmitting tubes. A 5-watt tube takes about 2.5 amperes to run the filament, which is pretty high, and it would be a considerable saving if the filament power consumption could be reduced as with the receiving tubes. We look forward to something like this.

What Are the Opportunities in Radio Factories?

(*Continued from page* 53)

for you if you get ahead. If you grumble with them now, they'll be grumbling at you then. Those in charge think they are doing what is best, just as you'll be doing what you think is best later on. If the other men feel that you trust those over you, they'll trust you when you are over them. No one dares to make a mistake intentionally.

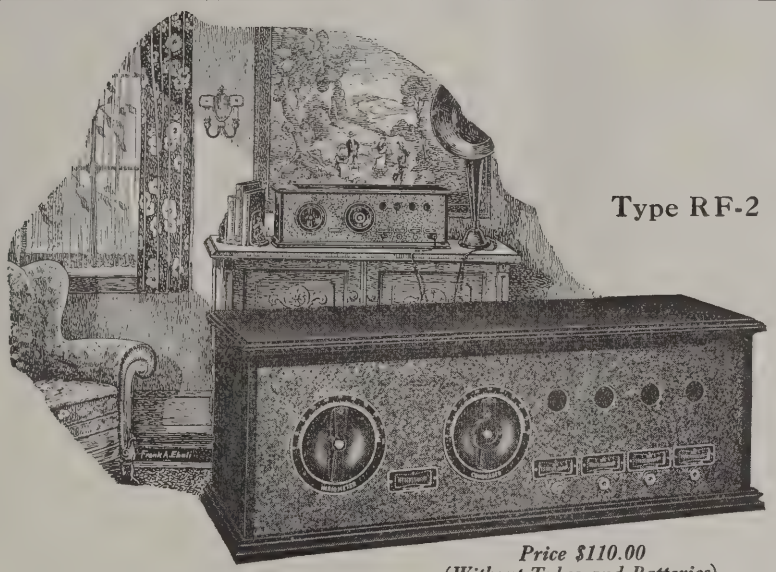
You will probably keep on building sets and making experiments at home. It is very handy to pick up a few parts here and there with so many lying around. But don't do it. Don't let even a soldering lug stray into your pocket. Everyone knows who is taking things. The men even admit it to each other. At the start, you have no direct responsibility to the company for the actions of the others. It is different matter, though, when you are foreman. Then, if you catch a man stealing, you can't afford to have him say, "Well, you used to take things yourself!"

The same thing is true of your workmanship. Suppose you are made an inspector. If you have been slipping things by, the others know about it, and they won't understand it if you are strict with them. They will think—"You're pretty wise now you're an inspector." Next thing you'd be in so much trouble that you would be put back on the bench, with another man at the inspection table.

There are plenty of chances in the radio factories for men who want to make good, and good salaries to be made. Shops all over the country are growing, for radio equipment has taken its place as a staple product for which there is a steady demand. Don't feel that, in another year or two the business will drop off and your time will be wasted. Rather, decide at once and

get busy if you are going to take up this work. Particularly at this time of the year you must not wait too long or the summer lay-off will begin. Above all, don't worry for fear that the field is over-crowded. For every job there may be ten applicants. Unfortunately, or fortunately for you, about one in twenty of those who think they are capable are good enough to be kept on the payroll. That's why a man who goes into it seriously and has the right attitude toward his work can so easily out-distance the others.

Of course, we all eat. Some of us support families. However much we want to work in a radio factory, we can't do it for love. A beginner of small experience cannot start off at much more than fifteen dollars a week, or twenty dollars for a skilled beginner. Experienced assemblers generally get twenty-five to thirty dollars a week. A man of extra ability, who can handle experimental assemblies and layouts, may get forty dollars. Inspectors get about thirty dollars, running as high as fifty dollars if they have had technical experience in correcting faults as well as finding them.



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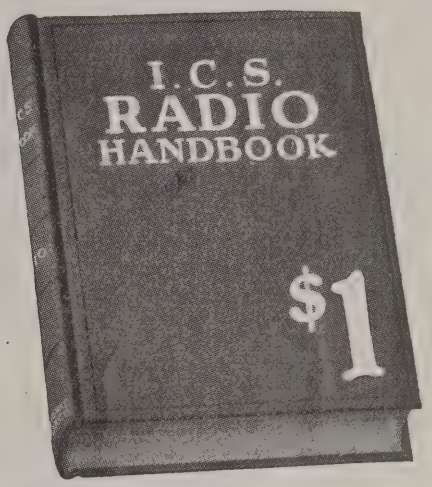

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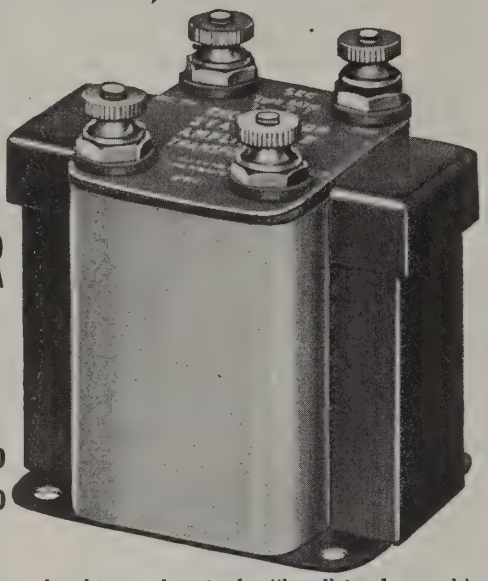

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are names that rank supreme in the receiving set world. The superiority of their apparatus does not depend on opinion, but is the result of careful construction and scientific selection of parts. All three use the Thordarson Super Audio Frequency Amplifying Transformer, for, after exhaustive tests, it was found to be most in keeping with the high quality of their sets.

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Beyond that—it depends upon your willingness to work. But if you forget all I have said, at least remember this: If you want to run a factory of your own, first practice in some other man's factory, and let him pay you to get the experience.

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The highest tonal quality undisturbed by either metallic noises or distortion is best obtainable with a fiber horn. This one factor is the reason for Fibertone's popularity. And the low price for such fineness is a sensation of the radio world. The beautiful crystalline finish of the Fibertone fits it for any place where the finer things of the home are seen.
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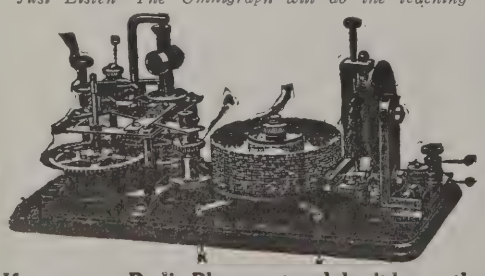

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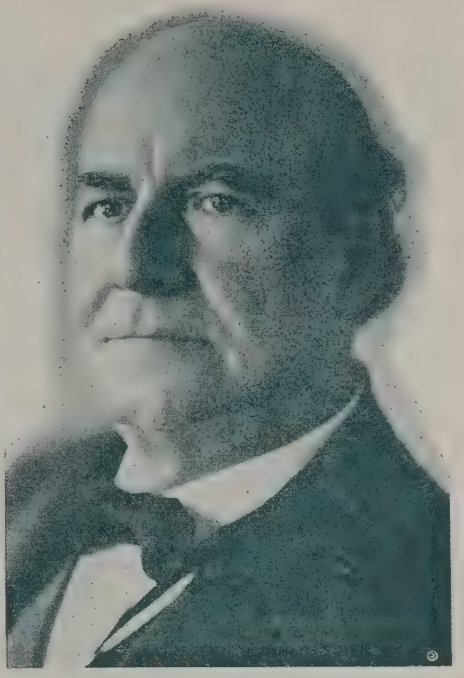
If you own a Radio Phone set and don't know the Code—you are missing most of the fun

William Jennings Bryan

Tells us

Radio will help bring World Peace



THE Radio is the greatest invention placed to the credit of human intelligence. It is the most wonderful thing that man has thus far drawn from God's storehouse of mysteries. It is so new and has opened a field so large that no one can estimate its future usefulness. Already it has brought music and instruction of many kinds to a constantly increasing number of people.

Being interested in the politics of the nation, I welcome the broadcasting station as a great instrumentality for the spread of information. It will not be long before candidates for local offices will be able to address their constituents over the radio just before election, thus being able to take advantage of all the information gained during the campaign. Even presidential candidates can address a large percentage of the nation the day before election, concentrating their arguments upon the contested issues and answering any misrepresentations that may have been made.

The abuse of so tremendous an influence would be so harmful, that the Government, acting for all the people, may be relied upon to insure fairness in the use of broadcasting apparatus, and, used with fairness, its value to the public will be inestimable.

It is not too early to calculate the use of the radio as a means of bringing nations into closer communication. When, in November, 1921, President Harding opened the largest wireless telegraph station in the United States, he received answers from twenty-six nations that read his message, the farthest being Australia. Peace ought to be brought nearer and war be more quickly banished from the earth when the executives of all the nations can confer as if around a council table.

William Jennings Bryan is one of the first of our big political leaders to realize the possibilities of Radio and to develop them. In this picture he is shown examining the apparatus that transmits his "winged" words to hundreds of thousands of listeners. This was in the Hotel Commodore in New York City, and with him are shown Mr. James W. Gerard, former Ambassador to Germany (turning the dial), Mr. J. W. Hughes, a lifelong friend, and Senator Edward I. Edwards. Station WJZ broadcast Mr. Bryan's speech on this occasion.

This appreciation and analysis of Radio was written expressly for THE WIRELESS AGE by Mr. William J. Bryan.

It is clearly of value to get an appraisal of radio from our great national leaders, and who in the forum of national life has impressed his character more indelibly upon us than William Jennings Bryan, silver-tongued orator and long the idol of a great national party?

All people will not accept his precise political and other pronouncements, but none will deny his mental calibre, his fighting quality, his high purposes or his great service to his country.

He is still a "young," active man of 64 and yet has been thrice nominated by the Democratic Party for President; has been Secretary of State and still is a foremost leader in many important movements looking toward reform and progress.

In his early political career he was renowned for a championship of tariff for revenue only, of bimetalism and of regional banks such as are now represented by our Reserve Bank System. He advocated constitutional amendments providing for an income tax, for woman suffrage and for prohibition. He has led the movement for prohibition like a knight in shining armor and is still in the lists.

As secretary of state in President Wilson's first administration he will be remembered chiefly for his negotiation of Peace Treaties with 32 nations.

Mr. Bryan is easily the most influential leader of the Democratic Party today and is devoting his great talents to combating the Darwinian theory of Origin of the Species and in support of the Volstead Act. And he is using radio.

A Radio Slant on Interesting Folk

Presentation of a Radiola Grand to the Governor of Honolulu, Hawaii. R. R. Carlisle, of the R C A is tuning in for the benefit of Governor and Mrs. Farrington

"Uncle" Joe Cannon gave up smoking for radio. After a brilliant career as Speaker of the House of Representatives, "Uncle" Joe intends to enjoy radio broadcast entertainment

The famous "Astor Coffee Dance Orchestra," which is officially known as B. Fischer & Company. This orchestra has for some time been a star feature on the programs of station WEAF. In "Peeps Into Broadcast Stations" another popular orchestra is shown. Both illustrate pertinently the widespread public interest in orchestral music since the advent of broadcasting

The Super-Heterodyne Receiver

By R. H. Langley
Radio Engineer, General Electric Company

The new super-heterodyne receiver which the Radio Corporation of America has added to its line of Radiolas

PERHAPS the easiest way to understand the Super-Heterodyne system of radio broadcast reception is to consider a mechanical analogy. Picture a simple pendulum. This will consist, let us say, of a billiard ball hanging at the end of a piece of slender string or thread.

If the upper end of this is fastened to some stationary support, such as a hook in the top sill of a doorway, the pendulum will swing when it is first put up, but will finally slow down and come to rest.

If the ball is now drawn slightly to one side and released the pendulum will swing and we shall find that it makes a certain number of swings per second depending primarily upon the length of the string. If the string is shortened the ball will swing more rapidly and will make a greater number of complete swings per minute. Let us take the pendulum off of the stationary hook and hang it from the center of a string, stretched quite tight between the two sides of the door. If we now start the pendulum, it will move the supporting string very slightly due to the fact that the string is not absolutely rigid.

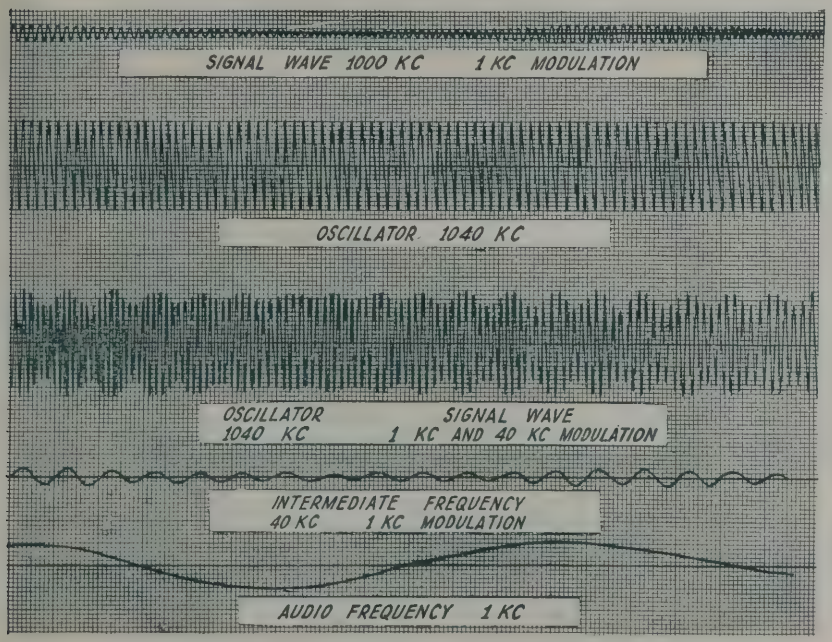
If we hang a second pendulum of exactly the same length as the first on this string, and start one of them going it will communicate its motion to the second pendulum through the string and the second pendulum will very soon swing almost as far as the first one did when it was started. When this time comes it will be found that the first pendulum has practically stopped swinging. The second pendulum will now drive the first one and in a few more swings the first pendulum will have all the motion and the second pendulum will be practically at rest. This interchange will go on back and forth, between the two pendulums until all the energy in the system has been dissipated and both pendulums will then come to rest.

Suppose now, that the second pendulum had been made slightly longer or shorter than the first one. The two pendulums would then have different frequencies of swing, and would not be in resonance with each other. If the first one was started the second one would pick up some motion from it, but not nearly so much as it would if they were of exactly the same length, and the first one would never stop entirely until the system came to rest.

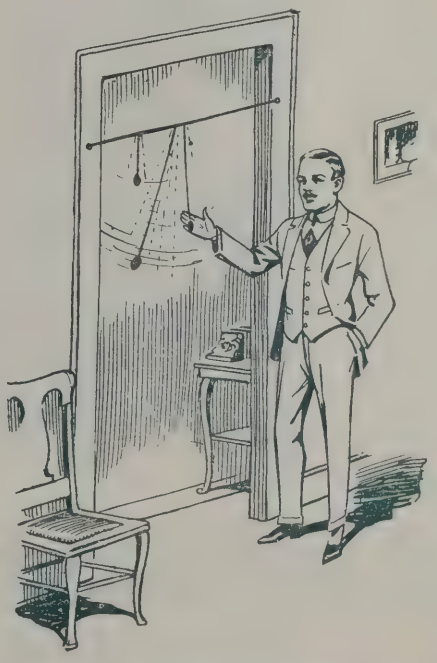
When the two pendulums are of different lengths consider what will happen to the string from which they are hanging. Remember that the string will move as a whole, that is, one part of it cannot move forward with one pendulum while the other part is moving backward with the other pendulum. What will this string do? It is being urged to move at two different frequencies at the same time. This it cannot do. The only thing it can do, and the thing which it does do is to move at a new frequency which will be found to be the difference between the frequencies of the two pendulums.

Suppose now that we hang a third pendulum on the string and adjust its length so that it will have a frequency exactly equal to the difference between the frequencies of the first two pendulums. When the two pendulums are put into motion they will move the

(*Continued on page 27*)


SIGNAL WAVE 1000 KC 1 KC MODULATION
OSCILLATOR 1040 KC
OSCILLATOR 1040 KC
SIGNAL WAVE 1 KC AND 40 KC MODULATION
INTERMEDIATE FREQUENCY 40 KC 1 KC MODULATION
AUDIO FREQUENCY 1 KC

Oscillogram showing relation between the different frequencies in the super-heterodyne receiver



Illustrating by pendulum the principle of the super-heterodyne

The Theater in Radio

Mary Pickford in "Dorothy Vernon of Haddon Hall." The inset shows a typical family situation—Douglas Fairbanks staging an exclusive performance for Mistress Mary. His exuberance is largely due to his having finished his "Thief of Bagdad"

The Theater in Radio

Being the Chronicles of One S. Pepys, Radio Fan

By William A. Hurd

THE theater in radio is more significant to me than ever it was before. It means that I can choose a play to my best liking without submitting to the tyranny of critics or the abominable council of my alleged friends.

In truth, the twirling of the dials on my radio set in quest of a good show will be a pastime comparable only to my present habit of browsing through a bookshop. The ecstasy of fireside abandonment can never be realized in public.

Selecting the particular play to my best liking will be a comparatively simple process of elimination. I do know that a play to be broadcast must of itself be good. There I have a standard.

Theatrical reviews imply something of the *noblesse oblige;* that note of finality I am not willing to accept. It seems to matter not whether they be authoritative. And if I am in company with a friend I find that I may not question the virtues of a dramatic criticism unless I question the viewpoint of my companion.

The theater has always engaged my interest, but I do find a greater fascination in radio. It is therefore pleasant to observe the theater — that institution ordinarily reluctant to emerge from its old crystallized forms —come to radio for its broadcast blessing and entertainment.

On the whole, I have found broadcast shows to be enjoyable; for good lines and lively music bring to me entertainment of a most delectable order.

Scenery and costumes cannot be broadcast. Broadcast announcers can attempt to do little more than describe the effect, which I find is often misleading much in the same manner that I discover my impression of a character in a book does not coincide with that of the artist. And so likewise do many unspoken situations lose much of their value in radio.

Constance Binney in Sweet Little Devil

Opera would lend itself in especial to broadcasting, for its situations are of small consequence. The entire plot is contained in two, or perhaps three, short paragraphs which the editor of the libretto chooses to label as the "argument," and by way of proving his contention, gives it front page space. The magnitude of some few opera settings can scarce be crammed into the limits of a stage—as those of Wagner. But I would lief as not employ my imagination, comfortably ensconced in a morris-chair at my radio, than struggle to peer under the chandelier from the family circle, four balconies above the privileged class who work their way down to grand tier boxes from positions of office boys.

I will enjoy drama on my radio when it has been properly developed for broadcasting. At such time, broadcast station personnels will include players who have radio personalities that supplement the so-called stage personalities. And before the microphone, characters need have no thought other than of their lines, which may well portray the author's emotions through voice inflection in an understandable manner.

* * *

The theater made its début in radio some time since when it was thought

The Theater in Radio

Mary Hay as "Mary Jane" in the musical comedy "Mary Jane McKane"

Ada-May and Harry Puck in "Lollipop" broadcast from WJZ

Fowler and Tamara in a specialty dance in "Lollipop"

Ada-May Weeks in the musical comedy "Lollipop"

musical reviews were in truth written for broadcasting. But I withheld my concurrence. I bethought me the producers of such extravaganzas were somewhat confused since none of us could be sure for what purpose they were intended. And it seemed to me that the broadcast announcers were themselves confused, what with disjointed scenes to explain, and situations so impossible the audience must see them to comprehend the joke which, forsooth, begins at the box office.

Wherefor, since musical reviews—which are on the order of extravaganzas—are ill-adapted to broadcasting, I must content myself with musical comedy. And I find it is not difficult.

In the musical comedy, scarce four minutes elapse between any spoken line and the next musical number. I am not beset with puzzlement when characters talk, for dialogue is of a light order to suit the plot. And whosoever would converse must cleave together lest I be at great pains to identify their voices in my loud speaker. It seems to me that any chance word will occasion the untoward entrance of the chorus, which needs no encouragement at all, and if the principals spoke at any distance apart there would be an unseemly confusion of tongues.

* * *

The public prints announced the broadcasting of Mary Jane McKane direct from the theater. And I did hail the announcement with great joy for I had never before heard a musical comedy on my radio.

Marjorie Gateson, one of the principals in "Sweet Little Devil," listening in on her radio in her dressing room between acts

Mary Hay and Hal Skelly seemed less concerned with the importance of their lines, which I deemed were very good, than how much fun they could have with their parts. And in truth they were merrier than ever I thought two stars could be in the same show.

Mistress Bertha Brainard, the winsome announcer for WJZ, was at great pains to learn the cue for each fade-out, of which there were five in the first act, because she might otherwise find herself trying to announce with no light at all, and her notes would then be of small consequence. And in that matter, I thought she was prudent for I have too often, myself, tried to locate a torch light in the dark. She did manage adroitly in her announcing since the operators had removed the control apparatus to the roof having been overcrowded back stage. And they changed their location so near the beginning of the show that Mistress Brainard was not able to arrange signals with the stage manager, which fact, alone, I thought would confound the most placid operator. Watching for a change of scenes at such great distance from the stage and yet explaining each episode in a fashion that was intelligible seemed to me a mark of courage.

The second act I deemed of less merit than the rest as there was scant music, so uncertain were the characters who would marry which other. But when the last act had done I was consoled in the matter of music for the producers were inclined to be doubly profligate, and I was minded to go straightway to a ticket vender and purchase a reservation in the front row, for I am unduly liberal in connection with expenditures on such affairs that please me.

* * *

I deemed myself in good fortune to hear Mary Jane McKane, so at my radio betimes, tuning on various meters, at great pains to learn how I should set my dials for Sweet Little Devil. After some reflection, I did decide that my receiver is a mystery which my understanding may never encompass, and I should not like such a scandal to get as far abroad as my own household. I tuned in, not the least knowing how it was accomplished, and I am content to leave such problems to those more learned in the art, which is, methinks, to leave them unsolved.

Constance Binney did so sparkle as a Sweet Little Devil, I deemed myself ill cast with such mortal stuff as clay. And all the players seemed live-

Virginia Smith and Nick Long, Jr. in "Lollipop"

lier than ever I thought any could be, and the next day I strove to learn by inquiry of the publicity agent if they were inspired before the microphone, which he stoutly denied, telling me that such capers would scarce compare with their frolics behind the scenes. So I bargained some time with him that I might see for myself such unseemly conduct back-stage, he being loathe to have publicity get into the public print, but to which I paid no heed, nor was he unwontedly depressed that I should have back at him with my pen.

Part of the cast of "Sweet Little Devil" listening in on the radio between appearances on the stage. The set is operated by the electrician who stands at the switchboard above

I must look to the improvement of my mind for there are many matters of which I am grossly ignorant, and it was only after I had gone behind the scenes that I learned actors are like other people. The characters of Sweet Little Devil have a radio back-stage which they enjoy between times of acting, and a receiving set provides them with as much pleasure as anything. I displayed my amazement, so arousing their mirth that an unseemly gale swept through the gathering, and a great lightness came in my head, and I bethought me of the cynical Mark Twain, who quoth, "All things are made lovely."

I did observe that microphones were distributed about the stage in such a manner that any one could be used for broadcasting without the others being connected. This, I learned, was necessary since the one placed in the footlights had to be cut off during dancing numbers because the foot steps would interfere with the transmission of the music.

The day passed in serious converse with the producer who methought was unfair in the matter of broadcasting only the one act, I striving to convince him that no play at all is preferable to too little. My discourse was so eloquent that I doubt if he will ever again want to see a radio fan. But the wisdom of my cajolery was borne out by the great number of telegrams and epistles received in response to the prize of a handsomely framed photograph of Constance Binney, autographed by herself, offered to the listener who first acknowledged the reception of the name of a relative spoken by Mistress Binney and next repeated by the leading man, and a like prize to the listener at the greatest distance from New York, the name being Uncle Sylvestor. Sweet Little Devil went off the air at 10:45 and the first reply came in at 10:50, but I am confounded to know of what greatest distance the show was heard as epistles seem never to stop coming, nor the most remote region yet heard from.

* * *

Early supper and at my radio, tuning in for Lollipop. I had been so pleased with the other musical comedies, I knew this one would afford me an evening of real luxury. And in that I was not disappointed. Ada-May Weeks does harbor a trait which I do like in all women, fortunate enough to be so gifted — the possessor's appeal to my protective inclination. And the producer was prodigal with music numbers much to my liking. A costume specialty in the last act, which of course could not be broadcast, annoyed me since it did lack any point, soever, on my radio, but I had great admiration for the adroit fashion of Mistress Brainard's announcing, she making it very lively.

In such good measure did the comedy lines of Lollipop make the issue between trade unions and exclusive society a seemly jest that I was mindful of what great moment a viewpoint can be to either one and yet be of no consequence at all. So I decided that I would fain purchase a ticket at such time that my purse was not put to it for the droll necessities of life, which I swear exceed my tenacity.

* * *

So up to see Mr. D. Fairbanks and Mistress M. Pickford, who had been persuadad against their will to broadcast from WJZ, and I did hail the opportunity with great joy, for both have won my esteem, which methinks is not peculiar to myself inasmuch as I did gain entry to the studio only with dexterity of a subtle order, there being so many about the place.

Mistress Mary was, forsooth, very pale, she being frightened before the microphone, which I thought would not happen if it had been concealed in a camera, but the studio manager would have none of my ideas, he striving to convince her that she need but

(*Continued on page 70*)

Wire Lines and Radio

Making Radio Waves Stand Still

MR. RANGER, the author of this article, gave a demonstration and lecture a few weeks ago before a meeting of the Washington branch of the American Society of Electrical Engineers, which was well attended by radio fans.

He pointed out how by means of a system of powerful sending stations located at widely separated points along the coast and connected by land wires, as illustrated in this article, it is possible to avoid interruption due to static disturbances and thunder storms by dodging them since we have a selection of several paths by which to send the radio waves.

By actually sending signals from the lecture hall in the Cosmos Club to Warsaw, Poland, and getting the signals relayed back, he demonstrated the speed of radio waves to his audience. Then, in order to impress the character of these waves upon his listeners, he made them slow down and finally stand still. For this purpose he used the long coils shown in the accompanying photograph. Connecting an oscillator to one end of the coil, he sent electric impulses down the coil. The speed of these impulses or waves was delayed due to the inductance properties of the coil. Moreover the distributed capacity was high, so that it was possible to reduce the speed of the electric waves to one-thousandth of the initial rate. Then since these waves started back from the far end of the coil they met the oncoming waves and thus an effect was produced of standing waves.

Mr. Ranger then pointed out a useful application of this principle. By means of a tape record made by a syphon recorder a ship is able to observe the standing waves as it passes them successively and from a knowledge of the wavelength is able to calculate its distance from the sending station, so that we have here a Radio Log for the further aid of navigation.

How Each Help to Make World's Communications of Greater Use to Mankind

By Richard H. Ranger

Member of the Institute of Radio Engineers

LIMITATIONS to radio? Certainly! But they are only relative limitations which are being overcome progressively. Selectivity in simultaneous transmission is a serious feature becoming more pronounced as radio uses become more extensive. But wave selectivity is marvelously efficient and will become more so as necessity demands it. In addition, the possibilities in directive transmission and reception will enhance the traffic capabilities of the ether enormously. May we not imagine the radio central of the future as the center of a hub of wires extending from the city out a little distance into the country, where directive transmitters and receivers extend the wire spokes into wireless rays to reach all parts of the globe instantly. The same wave length may then be used simultaneously on separate spokes of the radio wheel without mutual interference.

Think of the possibilities such an arrangement would lend to broadcasting. With a ring of high-powered stations connected to a central studio its superior programs could go out in all directions and cover the country.

Photo-radiography

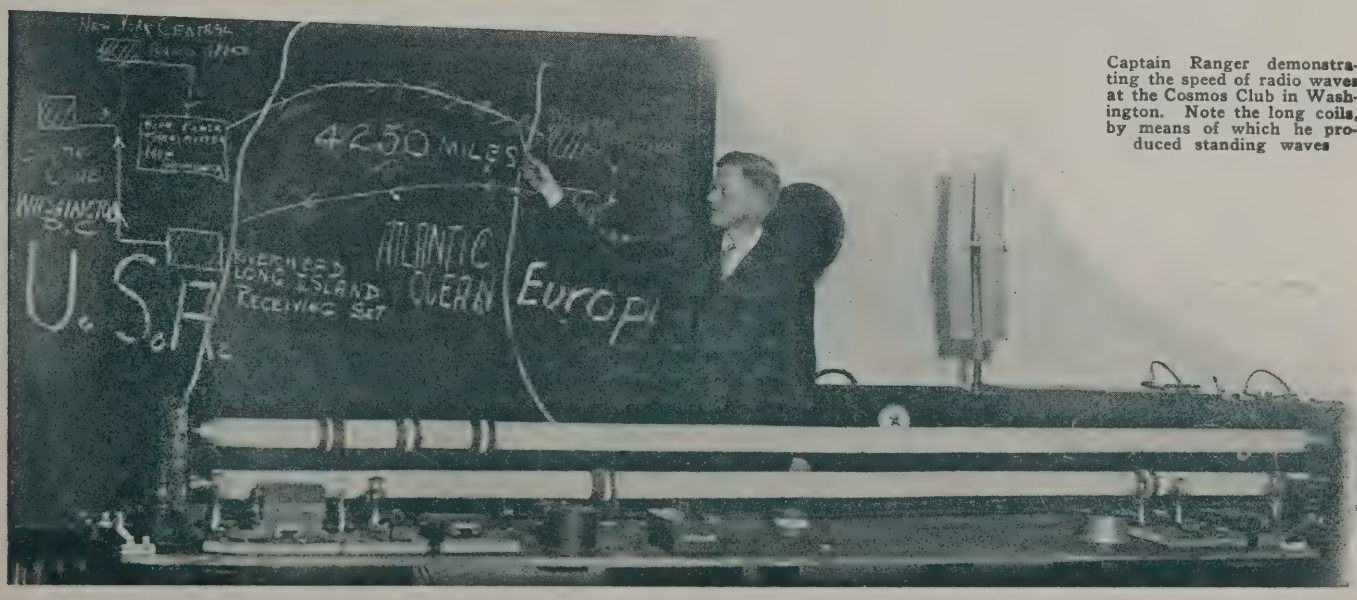
Fortunately, radio waves seem to keep their form pretty true throughout their entire journey. They may be absorbed or they may get chopped

Suggested plan for central studios and directional transmission from the city suburbs

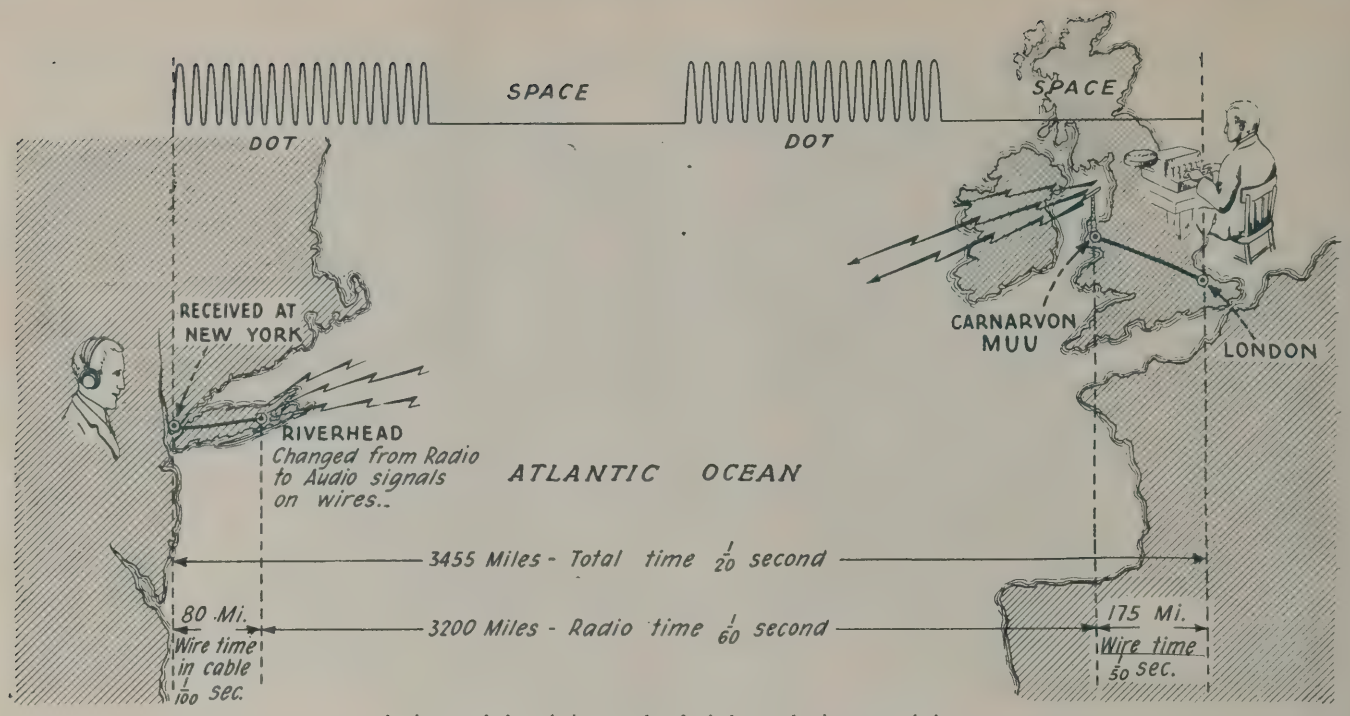
up by other ether waves, but such as do get through are true to form. No ether friction seems to exist which would change a sharp wave front into a long, drawn-out one with decreasing-ly small waves fore and aft, as happens with water waves, for example.

This characteristic opens up a new hope for achievement of the long-sought photo-telegraphy, such as has been attempted since light-sensitive selenium cells were first discovered half a century ago. For practical photo-telegraphy, the minute variations in light intensity of a picture must be communicated faithfully to the distant receiver. Radio offers this capability.

New devotees of the radio are not leaving it to radio engineers to venture such predictions as the foregoing. They are making confident prophecies themselves. And they are a fruitful source of speculation as to the future



Captain Ranger demonstrating the speed of radio waves at the Cosmos Club in Washington. Note the long coils, by means of which he produced standing waves



A picture of the relative speeds of wireless and wire transmission

of radio. Naturally one of the most common grounds for such speculation is the question: Will radio ever replace telephone lines? How long a lease on life have the telephone and telegraph companies when radio hits its real stride? We will look into that question.

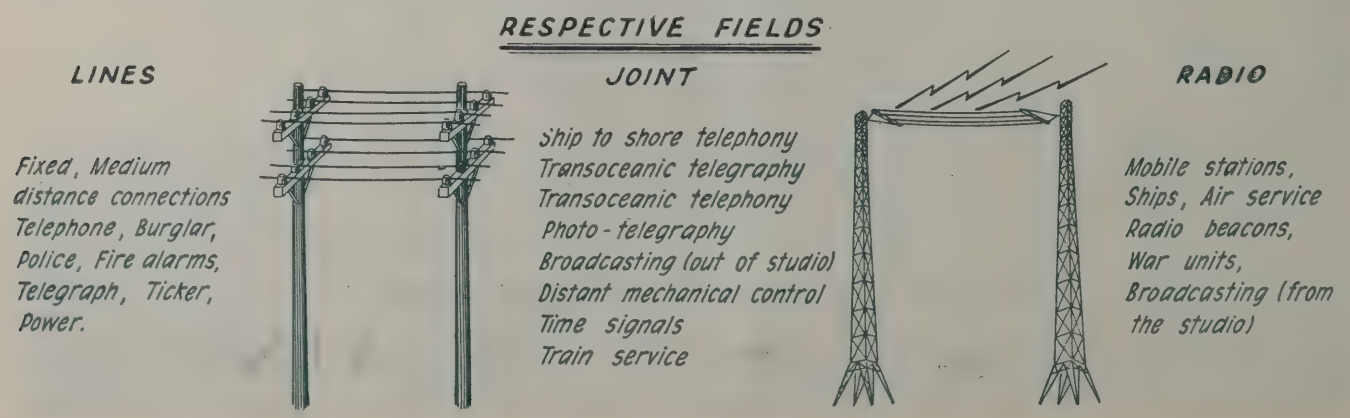
Radio will never reign supreme. Why? Because the ultimate question of whether one device or another will be used to do a given job is an economic function of how much each costs. Therefore in certain specific fields, wire lines will continue to be more practical, while radio will unquestionably supplant the wire lines in others, as well as setting up new fields that wire lines could never hope to touch.

That which will determine the real fields of wire lines and radio depends chiefly on the characteristics of the substances involved as the transmitting media. Wire lines go from one specific spot to another and as such afford the best means of selective intercommunication where large numbers of individual, simultaneous connections are desired, particularly for relatively short distances. In this field comes the telephone, burglar and fire alarms; telautograph or other indicating devices; local telegraph and ticker service.

Radio has pre-eminently the fields of mobile communication, such as to ships at sea and general dissemination of news now so wonderfully expanded into radio broadcasting. When airships and aeroplanes become more extensively developed, radio will be ready, particularly in the important "beacon" work, to be the radio lighthouses. The uncertainties of war give radio the distinct advantage in connecting the combat units. But it is to be expected that radio may have the more useful rôle of bringing all nations near together to rub off the sharp corners of overstrained elbows.

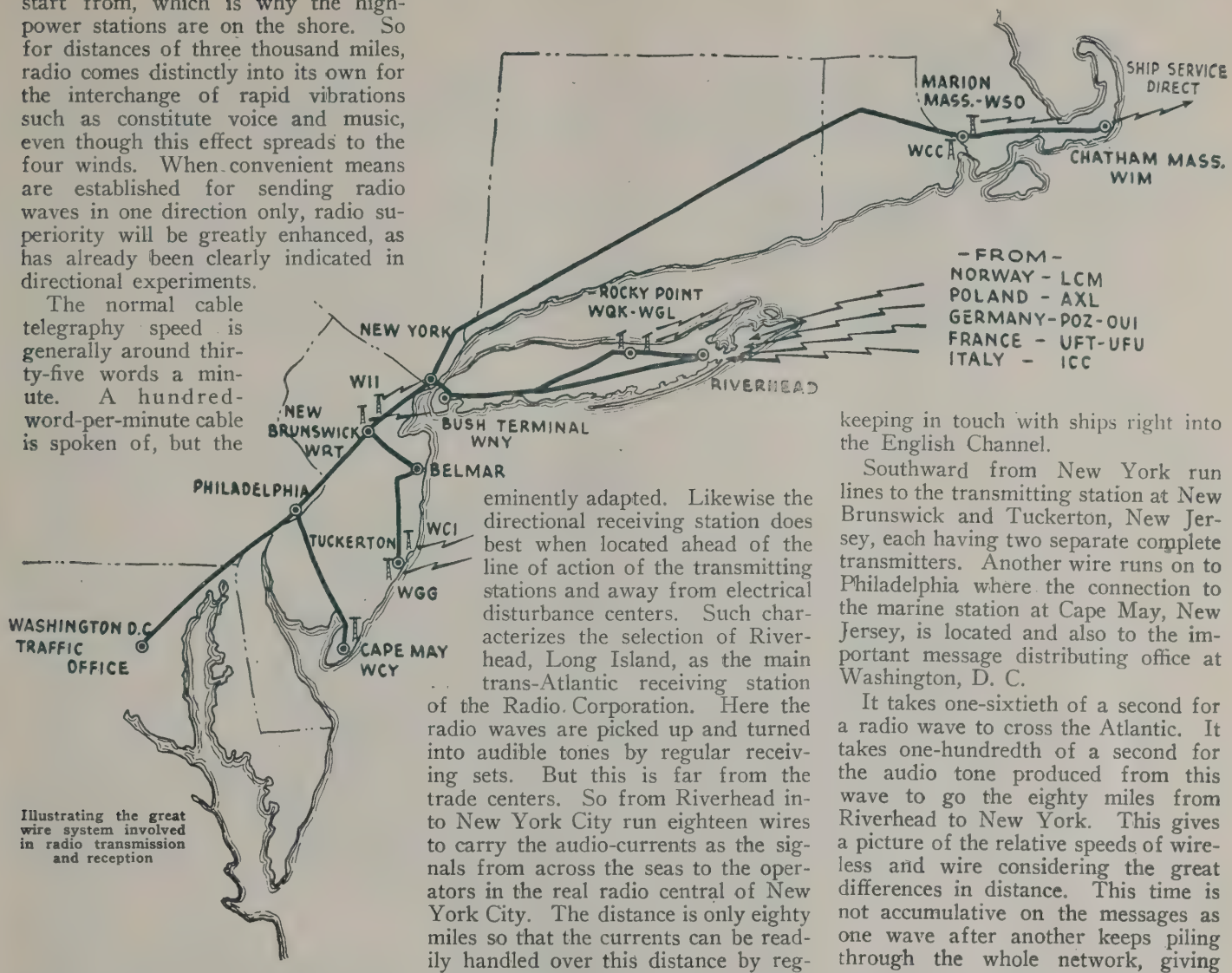
On the borderline between wire and wireless come the fields of long distance telegraph and telephone. It is extremely doubtful if wire telephony could ever bridge the Atlantic, even if it were economically sound. But radio has done that in a hit or miss way in the amateur tests, and in a regular way by the big trans-Atlantic stations when the high-power engineers set out to do the job. The question of when this will become a commercial reality only awaits the usual formalities of international as well as intercompany agreements.

The trouble with telephony over such great distances by wire or cable is of the extreme attenuation or decrease in the original signal input in traversing such long lengths of energy-consuming wire. Radio, too, is attenuated, chiefly at the sending and receiving stations themselves, due to the fact that our spreading wire antennas have a relatively poor hold on the "ether," which is the radio-conducting medium in space. But on long distances, these end losses become the lesser part of the whole loss. This wonderful enveloping layer of radio ether over the earth's surface is really a pretty good carrier of our words when once the waves have started. It makes a big difference where they



start from, which is why the high-power stations are on the shore. So for distances of three thousand miles, radio comes distinctly into its own for the interchange of rapid vibrations such as constitute voice and music, even though this effect spreads to the four winds. When convenient means are established for sending radio waves in one direction only, radio superiority will be greatly enhanced, as has already been clearly indicated in directional experiments.

The normal cable telegraphy speed is generally around thirty-five words a minute. A hundred-word-per-minute cable is spoken of, but the radio has already hit one hundred and twenty-seven words per minute across the Atlantic.



Illustrating the great wire system involved in radio transmission and reception

Here is where the joining of wire lines to wireless becomes of tremendous importance in over-all effectiveness. For transmission efficiency, the flat and even marshy coast lands are eminently adapted. Likewise the directional receiving station does best when located ahead of the line of action of the transmitting stations and away from electrical disturbance centers. Such characterizes the selection of Riverhead, Long Island, as the main trans-Atlantic receiving station of the Radio Corporation. Here the radio waves are picked up and turned into audible tones by regular receiving sets. But this is far from the trade centers. So from Riverhead into New York City run eighteen wires to carry the audio-currents as the signals from across the seas to the operators in the real radio central of New York City. The distance is only eighty miles so that the currents can be readily handled over this distance by regular wire telephone practice.

Other wire lines run all the way up to Marion, Mass., from New York to control the effective transmitting station at this point. Thence other wires run on to Chatham, Mass., where a most effective marine station has been built up which has many records of keeping in touch with ships right into the English Channel.

Southward from New York run lines to the transmitting station at New Brunswick and Tuckerton, New Jersey, each having two separate complete transmitters. Another wire runs on to Philadelphia where the connection to the marine station at Cape May, New Jersey, is located and also to the important message distributing office at Washington, D. C.

It takes one-sixtieth of a second for a radio wave to cross the Atlantic. It takes one-hundredth of a second for the audio tone produced from this wave to go the eighty miles from Riverhead to New York. This gives a picture of the relative speeds of wireless and wire considering the great differences in distance. This time is not accumulative on the messages as one wave after another keeps piling through the whole network, giving one, two or even three operators all they can do to change the dots and dashes into typewritten messages.

So wire and wireless unite in the radio art to give to the country the most economical and effective service that these sister arts of electricity have yet to offer.

The Super-Heterodyne Receiver

(*Continued from page* 19)

supporting string at the new frequency and the string will swing the new pendulum at exactly its own period and it will consequently be set into motion.

Now the first pendulum represents the incoming radio waves. The second pendulum represents the wave produced by the oscillator tube in the receiving set. The third pendulum represents the so called intermediate frequency amplifier. This is an amplifier built to work at one particular frequency, and because it is so built, it can be made very efficient, much more efficient than any amplifier which is required to work over a considerable range.

The incoming radio wave may be anywhere from 220 to 550 meters wave length which corresponds to frequency ranging from 1,360,000 to 545,000 cycles per second. An amplifier cannot be built which will amplify all of these various frequencies equally and effectively. If, however, we have a tube in the receiving set oscillating at any frequency to which we desire to adjust it, we can arrange matters so that the difference between the frequency of the incoming wave and the frequency of the local oscillating tube is exactly the frequency which the intermediate frequency amplifier has been built for.

As we change from one broadcasting station to another and consequently from one frequency to another, we change the frequency being produced by the oscillator an equal amount so that the difference is always the frequency of our amplifier. That this result has been accomplished by the adjustment is indicated by the signal received in the loud speaker. In other words there is no response in the loud speaker until the frequency of the local oscillator has been adjusted to the proper relation with the incoming signal, namely, that which gives a difference equal to the frequency of the amplifier.

Another advantage of this method is that the intermediate frequency amplifier can be made very highly selective to tune out interference.

Just think what radio will do for the little red schoolhouse!

Radio in the Schools

Superintendent Paul C. Stetson, head of the public schools of Dayton, Ohio, says that radio in the school provides recreation, encourages scientific studies, inspires to artistic development and destroys provincialism

By Truman B. Mills

READIN', Ritin' and 'Rithmetic made up the three R's in the curriculum of the Little Red Schoolhouse days. Not many of us can remember that far back, but all of us are aware of the fact that great strides have been made in school work in the past decade. Among the latest additions to the three R's has been Radio.

Schools have been notoriously slow in adopting new methods during the past and this habit has interfered with the extension of the radio to school work. There are always those who hold to the old ways and fight the introduction of the new and the novel.

"We got along all right in the old days," the conservative school board member declared. "Just look at the big men that were turned out by the little red schoolhouse. All these new fangled methods only add to the taxes," the cheese-paring educator complained.

As a result the radio has had to take a back seat in the school affairs of most cities. But not so in Dayton, Ohio. Realizing that this modern scientific marvel is destined to play a big part in our lives and that the fullest use should be made of it in our everyday activities, Dayton educators were among the first to adopt the radio as an adjunct to present day educational methods.

Superintendent Paul C. Stetson, head of the Dayton schools, is very enthusiastic over the use of radio in education

Although the introduction of the radio was tried out first as an experiment in school work, it has now become an established part of the educational system, and is being expanded to meet the growing demands of teachers and pupils.

Results far beyond expectations have been obtained through the use of the radio in the schools, and plans are now under way to make Dayton one of the foremost cities in the United States using the radio. Pupils have taken an extraordinary interest in the innovation both from the standpoint of broadcasting and receiving.

When first suggested, it was thought that receiving stations only would be established in the various schools so that the pupils of the grade and high school departments could take advantage of the programs that are being broadcast daily throughout the country. Later, through the interest and enterprise of pupils and wide-awake faculty members a broadcasting station was established in Parker high school. This is one of the four high schools of the city and is given over to training of the freshman students.

At the outset the board of education made an appropriation of several hundred dollars for the purchase of equipment and installation. This was of course only the preliminary move. Additional money has been expended and a complete broadcasting outfit has been purchased.

Stivers and Steele high schools now have receiving stations and the grade schools of the city are one by one putting in instruments for receiving. The new Roosevelt high school, which is just being completed and which will be one of the largest and finest equipped high schools in the United States, will have a receiving station.

The Parker station is WABD, and has an assigned wave length of 283 meters, or 1060 kilocycles. The operating schedule has been on Friday night of each week from seven to eight o'clock. Plans for the future call for operation two or three nights of each week, as material is being gathered together which will require a

Radio has been added to the three R's. Students are taught how to broadcast programs as well as how to manage apparatus

lengthening of the present schedule. Paul Jackson, who was graduated from Steele high school last June, is the commercial operator in charge of the station. The outfit used is a Western Electric CW-931. The users report that it is giving very good service.

The programs for the most part have been made up of talent taken from the student body, but as there has been a demand on the part of outsiders to come in and furnish programs it has been necessary to put some restrictions on the use of outside talent in order to give the fullest play to pupils. Any pupil who is capable of playing a musical instrument, of singing, reciting or reading, is invited to apply for a place on the programs in as many numbers as he, or she, wishes to appear.

Here, then, is one use of the radio in the schools that tends to develop the latent talents in the pupils and causes them to aspire to greater things in self-expression. It is not hard to imagine how elated a young person is when he is permitted to take part in a radio program and send his voice out through the air! But this is only one of the ways the radio excites interest among pupils.

There is a feeling among the school folks and parents that the future holds much in the way of radio development in educational work. One of the proposed plans calls for the broadcasting of talks of distinguished persons that come to Dayton. Take for instance a recent case: Roy J. Snell, the arctic explorer and writer, was in the city and gave interesting talks in the schools. As it was, he had to go around to the different school buildings to reach the thousands of children. In the future it is planned to have such speakers give their talk in one school and broadcast the speech to the pupils of other schools all at one time, thus saving much time and effort.

Superintendent Paul C. Stetson, head of the Dayton Schools, who is very enthusiastic over the use of the radio, said:

"In a recent article by H. G. Wells, this noted English author made the interesting observation that in a short time our educational methods would be completely revolutionized due to the two great inventions of moving pictures and the radio. Mr. Wells predicts that, in a short time, textbooks will be discarded by the public schools and that lectures will be delivered on science, literature, history, etc., by means of motion pictures. He states that the possibilities of the use of motion pictures have not been realized in the slightest degree. The radio is classed by Mr. Wells as one of the greatest boons to modern civilization. It is his feeling that in a few years, students will assemble in a lecture room and hear lectures on chemistry or physics by the most famous scientists in the United States.

"Although Mr. Wells may have allowed his enthusiasm for moving pictures and radio to carry him too far in his prediction of what will happen to the work in the public schools, that these two great inventions are having. and will have, a profound effect on our educational system, will not be doubted.

Parker High School in Dayton, Ohio, where radio is part of the school curriculum. This is station WABD

"Dayton is fortunate in having made a very good beginning in the use of both motion pictures and the radio. Our plan for visual education has become widely known as the Dayton Plan and is being used extensively in many cities. Dayton is one of three school systems in the United States which now hold broadcasting licenses.

"There are four main purposes in the use of the radio in the public schools in Dayton at present. In the first place, we are trying to develop interest in the radio as a means of education for the pupils who belong to the radio clubs. There are no organized classes in the radio work, but many of the lectures which are received over the radio are of an educational nature. We are attempting to correlate some of the work of our music department with the concerts which come over the radio. In the second place, we feel that having both the receiving and broadcasting stations serves to stimulate research work in electricity. The radio club has a real educational and technical value. Many of the young men who are members of this club are acquiring a real interest in scientific problems through their contact and work with radio. In this way it provides a valuable function in vocational guidance. We do not know how many young men may be stimulated to follow scientific lines by having their interest aroused through membership in this club.

"In the third place, the radio in the schools is quite important since it has a definite recreational value. The schools of today are more than places where children are grouped together to learn certain definite lessons. A very important part of the modern school is to provide the right sort of recreation. Through the installation of a radio station it is possible for us to entertain large groups of students with the very best lectures and music. It has a fourth value—namely that of promoting sociability among the entire student body.

"We trust that the radio stations in our various schools will be valuable in enlarging the pupils' horizons. A great country like America tends to break up into small groups which allow their social provincialism and prejudice to work against the country as a whole. The automobile has been a great factor in breaking up this provincialism and prejudice. It is no uncommon sight to see cars from Texas, California, Maine, Florida and Michigan, parked side by side on the streets of any large city. This means that these people are going back home with a broader vision and new ideas of what constitutes their country. We hope that the radio will have the same effect. When a class has heard a concert from Pittsburgh, they will unconsciously become more interested in Pittsburgh. It will cease to be merely a name and will become more of a reality. When one can be in communication with people thousands of miles away, he will no longer harbor narrow prejudices which are a drawback to the broad development of any country. The development of radio is certainly in its infancy. No one would be so foolish as to predict its future, but it is a source of satisfaction to know that the various high schools and elementary schools in Dayton have been wide awake enough to take advantage of this great invention. It will be a factor in building up a complete school system."

"The Heart of Radio"

Vacuum Tubes Worth $3,500 Operated to Gain Information as to Their Characteristics and Length of Life for the Benefit of the Radio Fan

By W. C. White
Engineer, General Electric Company

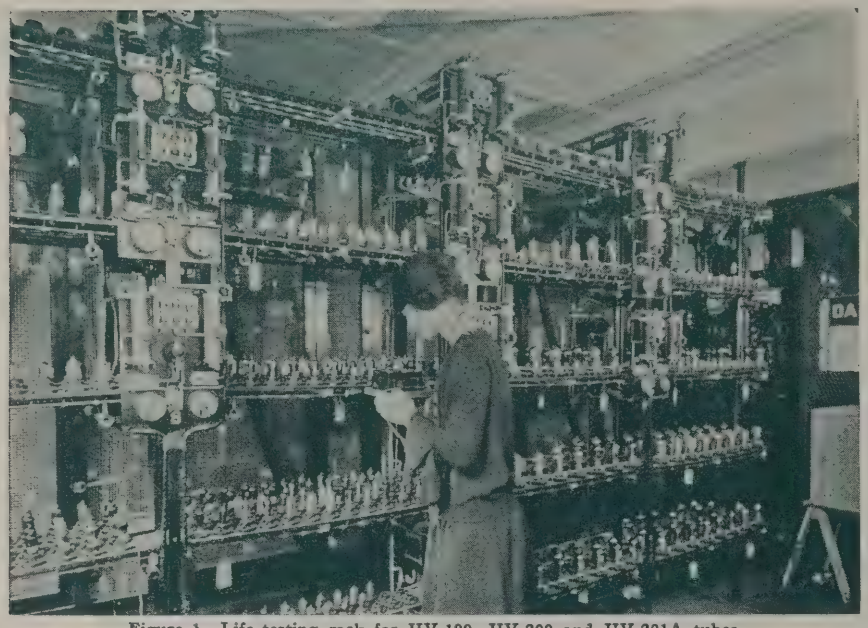


Figure 1—Life testing rack for UV-199, UV-200 and UV-201A tubes

THE General Electric Research Laboratories are usually thought of as the birthplace of many new electrical developments, such as the drawn tungsten wire incandescent lamp, the gas filled Mazda lamp, the Coolidge X-Ray tube, the Pliotron and the X-L filament vacuum tube, to mention only a few of its many contributions. This laboratory, however, has another very important function to perform in the service that it renders the various affiliated manufacturing groups.

The most widely known example of this is Mazda Service which is carried on in relation to the manufacture of incandescent lamps. Mazda Service is not directly rendered to the individual purchaser of lamps, but to the manufacturing groups where these lamps are made. This Mazda Service includes not only gathering and distributing of lamp manufacturing information, but also systematic and periodical examination of the quality and characteristics of the lamps under manufacture at the different factories. This service results in better lamps to the public.

A considerable number of the problems involved in the manufacture of vacuum tubes are identical to those of incandescent lamp making, and in the case of Radiotrons, uniformity and quality are, if anything, of even greater importance than in lamps. At the same time, the manufacture of these tubes requires a somewhat new technique in comparison with lamps, and therefore, this problem of good quality and uniformity is much more difficult.

About a year ago a rather extensive system of Radiotron service to be furnished the factories by the Research Laboratories was outlined and shortly afterward put into effect.

For each type of Radiotron manufactured certain allowable limits of variation in the different constants have been assigned. These cover, among other things, the electron emission, the amplification, the plate current and the electrical measurement of vacuum. On account of the large production of tubes, and the fact that every tube manufactured is given several different tests, this necessarily requires a considerable number of rather complex testing equipments. An important part of these testing equipments is the various voltmeters and milliammeters used for obtaining the constants of the tubes.

Once a month a representative of the Research Laboratory makes a three- or four-day visit to each factory. His first duty is to check the various instruments on the test sets, as upon the reading of these instruments the whole test procedure and result are based. Next, the general operation of the test sets is gone over in considerable detail to see if their general behavior is satisfactory.

About twenty-five tubes of each type under manufacture are then picked at random from the shipping room and these are re-tested by the laboratory representative in the factory test sets as a check on the accuracy of these sets. In this way the possibility of unsatisfactory tubes passing the factory tests is largely eliminated.

In addition to the regular testing sets, each factory is equipped with special apparatus for measuring such constants of the tube as impedance, filament amperes at rated filament volts, amplification constant, mutual conductance and input impedance. This equipment is frequently used by the factories in checking their daily production.

The sample tubes selected for examination are then tested in these special equipments to obtain information as to the average values of these various constants, and also as we shall see later as a check on the testing equipment itself.

The factory engineers are continually testing the constants of their manufactured product and taking the proper steps to see that these constants are kept within the proper limits. The duty, therefore, of the laboratory representative is primarily to be certain that the factories have testing equipment that is in perfect working condition and that they obtain correct results in using it.

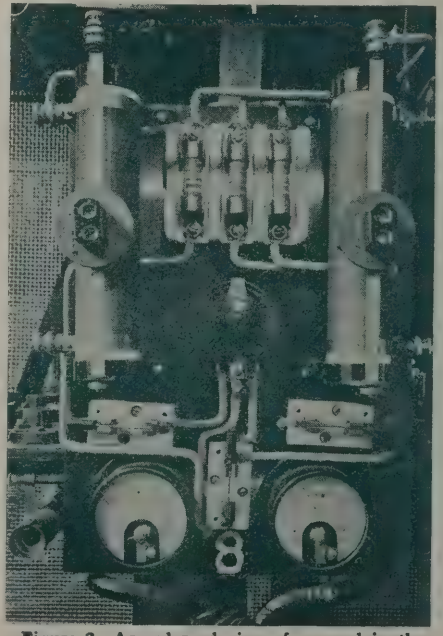


Figure 2—An enlarged view of a panel in the testing rack

To this end the sample tubes which were originally selected from the factory shipping room are brought back to the Research Laboratory and all the tests repeated on a standardized equipment maintained for this purpose. All of these measurements are carefully examined for discrepancies so that any such discrepancies can be investigated, the cause found and the remedy applied. This process that has been described, therefore, indicates and checks the average product of each factory, but of still greater importance, gives assurance to the factory engineers that their various pieces of testing equipment are in satisfactory condition and can be depended upon. The first few months that this system was in operation a great deal of difficulty was experienced in making the various equipments give results that checked within the desirable limits of error, but since that time variations in the results from the testing equipments have been rare.

Reports are then made out covering the complete series of tests on these tubes, showing the quality and uniformity, and copies are forwarded to each of the factories.

The sample tubes that form the basis of this testing procedure have not, however, ended their usefulness at the close of these tests. About one-half of them are put on a life testing equipment located in the Research Laboratory. For each type of Radiotron there have been assigned standardized electrical conditions for life test, such as filament voltage, plate voltage and grid voltage.

In addition to these samples obtained from the factory every month, each factory ships weekly to the laboratory a few tubes which are also put on life test.

This rather extensive life testing equipment is interesting and its construction and operation will next be described. The equipment utilizes two rooms, one in which the tubes are continuously operated during their life and the other room containing the testing equipments in which the tubes are tested for their performance and various constants at frequent intervals during their operating life.

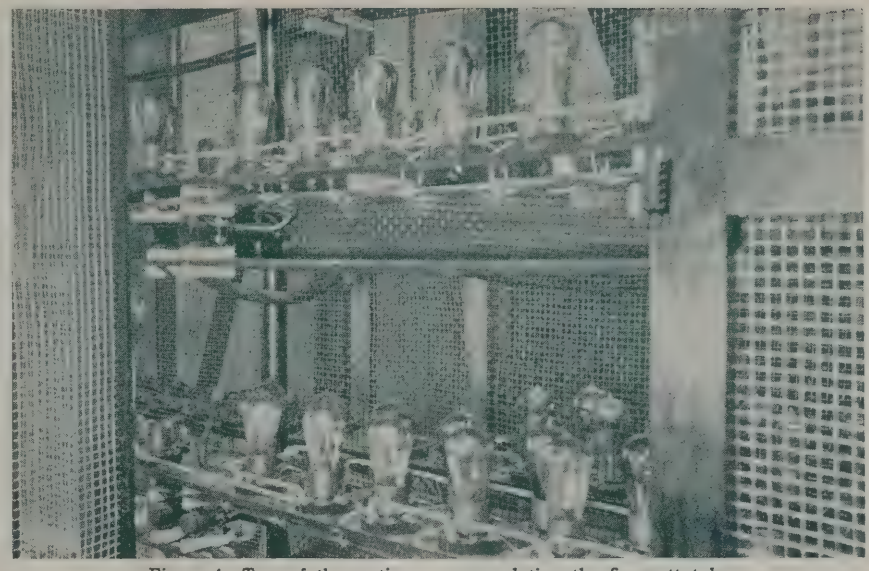


Figure 4—Two of the sections accommodating the five-watt tube

The life testing "rack," as it is called, for the UV-199, UV-200 and UV-201A tubes is shown in figure 1. This rack contains slightly over five hundred sockets for the UV-199 tubes and over three hundred standard sockets suitable for the UV-201A or UV-200 tubes. On a second rack are also included about 250 sockets for small power tubes, using the standard base. In addition, ninety sockets for the fifty-watt type of tube, and thirty-five for the 250-watt type are included.

The equipment for receiving tube life testing which will first be described is divided into thirty-two sections; that is, it is possible to carry on simultaneously life tests under thirty-two different conditions as regards filament voltage, plate voltage and grid voltage. Adjustment is provided for any filament voltage throughout the entire working range of the tube. Any plate voltage between 0 and 125 can be utilized and any negative grid voltage up to minus fifteen volts is available on each section. Sixteen of these small control panels can be seen in figure 1 and there are sixteen similar panels on the opposite side of the rack.

An enlarged view of one of these panels is shown in figure 2. In the lower right hand corner of this panel is a small voltmeter which indicates the plate voltage. This voltage is controlled and set at any desired value by one of the slide wire resistance units located above. The other slide wire resistance unit is used to adjust filament voltage. This voltage must be set and maintained with great accuracy, a far greater accuracy than can be indicated by a small type of instrument suitable for location on these panels. For this reason a special highly accurate voltmeter which is calibrated against a standard at frequent intervals is used for testing the various filament voltages. Figure 1 shows the young lady in charge of the life testing equipment making this filament voltage check on one of the sections. This voltage is checked three times a day.

Referring again to figure 2, the small circular potentiometer rheostat shown in the center of the panel is used to control the negative grid bias applied to the tubes. The value of this grid bias voltage is indicated by the voltmeter at the lower left hand corner of the panel. Three fuses and three single pole switches are provided, as shown on the panel, to protect and control the plate, grid and filament circuits.

Located near the side of each of the voltmeters shown on the panel of fig-

Figure 3—Testing for electron emission, state of vacuum and general operation of tube

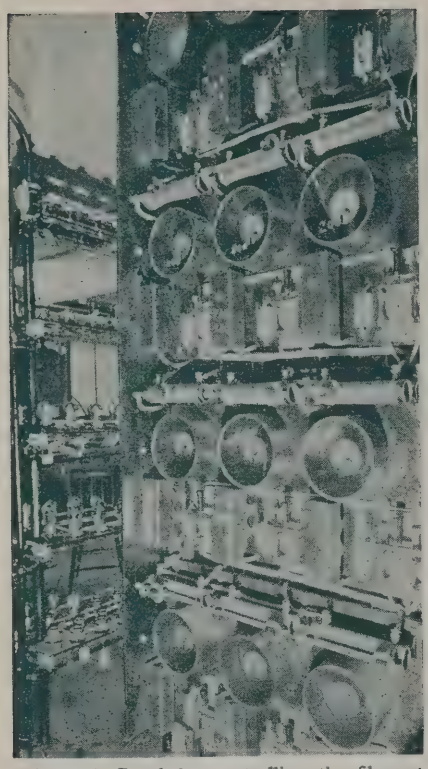


Figure 5—Panel for controlling the filament and grid voltages

ure 2 a resistance stick will be noted. This resistance is bridged across the filament leads and draws a filament current equivalent to that of several tubes. The function of this resistance is to minimize to an unimportant value the fluctuation of filament voltage on any particular section when the filament of one or more tubes burns out.

Four of the sections used in receiving tube testing are much larger than the other sections and are maintained under the standard test conditions. On these sections are tested the sample tubes obtained weekly and monthly from the factories. The remaining sections are smaller, containing only from twelve to thirty sockets each and are used for running special tests.

Methods of improving the manufacture of detail design of the tubes are continually under investigation and also many special tests are made to determine the effect of various changes in mode of operation upon tube life. No change in the design or method of manufacture of the tubes is made until life tests have indicated that this change does not exert some unforeseen or detrimental effect upon the life or quality of the tube. For these reasons a majority of the special testing sections are continually in use.

In the standardized life test the tubes are removed in general from the racks at 25, 50, 100, 250, 500, 750, 1000 hours and at further intervals of 250 hours, and tests of electron emission and vacuum and a general operating test are made. The making of these tests is shown in figure 3.

Initial tests on tubes before they leave the factory and pass into the hands of the consumer through the dealer are, of course, very important, but of equal importance is assurance that these same tubes will not deteriorate after a short life in the hands of the user. It is for this reason that these tests are made on the constants and performance of the tubes at intervals during life.

A second rack similar in general construction to the first is used for the life testing of the group of power tubes comprising those of 5, 50 and 250-watt types or any others of the same general characteristics and voltage. This entire rack is enclosed in screen meshing. This meshing is clearly seen in figure 1 back of the receiving tube rack.

Figure 4 shows two of the sections accommodating the five-watt type of tube, one of the screen doors being open. The power tube testing rack has plate voltages varying between 350 and 2000 and safety switches are provided on each of the screen doors so that this high voltage is automatically disconnected if any of these doors are opened.

Four sections are provided for the testing of the five-watt type of tube. All of these sections are supplied from a common high voltage source, but each section may be operated at a different filament or grid voltage. In a similar way the fifty-watt type of tube can be tested on four sections, all of these sections being supplied with a plate voltage of 1000 D. C. Four sections are also provided for the testing of the 250-watt type of tube, a common plate voltage of 2000 being provided.

On account of the high voltages, the control for these power tube sections is largely centralized at two points. Figure 5 shows the panel for controlling the filament and grid voltages. For

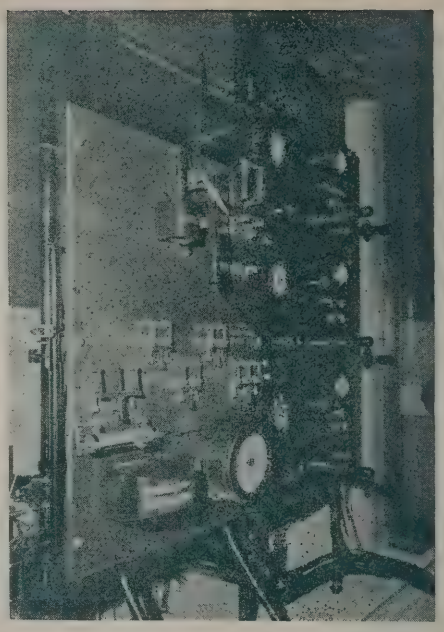


Figure 6—Panel for controlling the plate voltage for the 5, 50, and 250-watt sections

convenience, the plate current meters are also included on this panel. Owing to the fact that these individual plate current meters for each section must be at high voltage, they are protected by grounded metal cases with glass fronts. Therefore, from this centralized panel the grid voltage and load on each tube can be adjusted.

The left hand panel of figure 6, which is divided into three horizontal sections, controls the plate voltage for the 5, 50 and 250-watt sections. Each of these three-panel sections contains a plate voltmeter, a main disconnecting switch of the plug type, an ammeter showing the total load and a rheostat and switch in the field of the generator.

A great many of the power tubes are of such a low impedance that with rated voltage on the plate and without a negative grid voltage the plate current would be very high so that the heating of the anode would be ex-

(*Continued on page* 35)

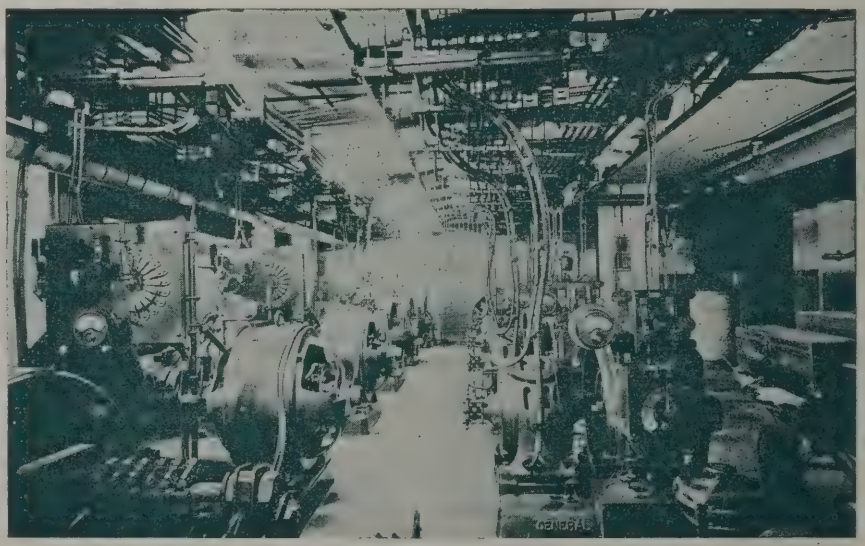


Figure 7—A group of machines which illustrates a portion of the laboratory equipment

Radiosyncrasy—First Prize

A WIRELESS AGE Receiver Awarded for This Title Selected From Over One Thousand Submitted

A WIRELESS AGE Receiver to be Awarded to the Winner of "Radio in the Home" Contest

THE WIRELESS AGE received well over one thousand titles in the February-March contest.

First prize, THE WIRELESS AGE Reflex Receiver (described in the February issue) was awarded to A. G. Kuehn, Bristol, Oklahoma. His suggestion for a title was "Radiosyncrasy."

The ingenuity of Radiosyncrasy may be seen in the analysis of its root derivation: Radio (its own sweet self), syn (with), and krasis (mingling or mixing) from the Greek; which gives us an interpretation for the picture: mixed up radio. The inventor of this new word, which may easily become famous, probably had also in his mind such suggestive ideas as "idiosyncrasy," "syncopate" and even "crazy."

Second prize, five dollars, was awarded to E. B. Correll, Milwaukee, Wisconsin. He offered the title: "Youth and Age on Different Meters.'

Unquestionably, youth and age have been, and probably always will be, on "different meters." In fact, the old issue between youth and age was never more aptly expressed.

Third, fourth and fifth prizes, a year's subscription to THE WIRELESS AGE, were awarded to Stephen J. Leo, Jersey City, New Jersey; G. A. Wendling, Troy, New York, and J. P. Bucher, Newport News, Virginia. The titles suggested by each were respectively, "Broadcasting the Haunts and Habits of Delayed Husbands." "A Subject for Reflex-ion," and "A Child Shall Lead Them."

Winning Titles

1.—Radiosyncrasy.
2.—Youth and Age on Different Meters.
3.—Broadcasting the Haunts and Habits of Delayed Husbands.
4.—A Subject for Reflex-ion.
5.—A Child Shall Lead Them.

Each of the three titles very nearly won second place in the contest. "Broadcasting the Haunts and Habits of Delayed Husbands" could have been a little more unique in its phrasing. "A Subject for Reflex-ion" was one of several titles on the same general thought which directed the attention of the reader to the subject itself and the study of it. "A Child Shall Lead Them" was the only title that pertinently expressed the idea of the younger generation leading the elders in radio.

The majority of titles received had letters attached commending THE WIRELESS AGE for presenting an illustration that portrays a situation with which all were familiar. A few were so enthusiastic in their praise they actually forgot to offer any suggestions for the title itself. We observed, however, that such titles found their way into the office soon afterwards.

Quite unsolicited, contest letters have come in great numbers commending the general excellence of THE WIRELESS AGE, offering suggestions of future articles desired, unbiased criticisms of recent issues, and in general, indicating a very real interest in the progress of the magazine. All such letters were pleasing, and the more appreciated because they were sent of the writers' own volition. The response manifestly arose from the contest which was unanimously voted worth while. Current opinion is evidently that such contests bring home to the reader the "human side" of radio.

Many suggestions were based on "Jazz" and various modifications of that title. Others were "Interference," "Papa Loves Mamma," etc., "Static," "No Place Like Home," and other titles of songs, comic strips and popular phrases.

The "Radio In the Home" contest, announced in the April number, will assuredly be a like success. Those who were less fortunate in the last contest may enter the new one with better assurance of success.

THE WIRELESS AGE Contests are strictly a family game in which all readers may participate. The prime motive is, and will be, a spirit of play of an evening, between times of tuning in on the radio.

So let's see how much fun we can have in the new one.

—THE EDITORS.

Radio in the Home Contest

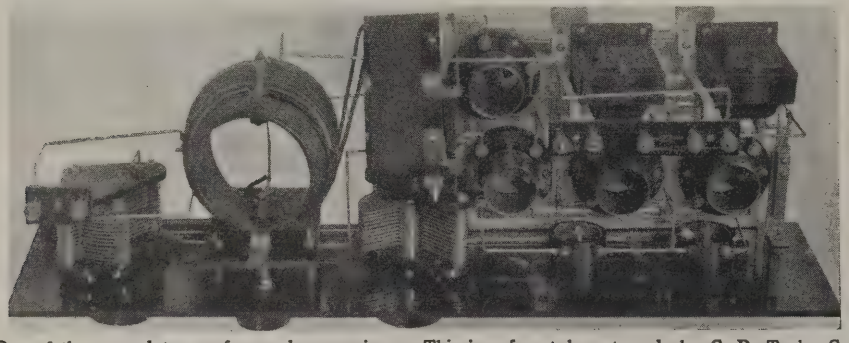
THE NEW CONTEST—RADIO IN THE HOME

Just send us a snap-shot or photo of your radio set showing how it is arranged to fit in harmoniously with the surrounding furnishings. The above photo illustrating a Cutting and Washington Receiver is a good example. If your set is "home-made" it will do just as well. The best photo will receive a Wireless Age Receiver (described in April number) as first prize. Second prize, $10.00. Third prize, $5.00. Next ten best photos, a year's subscription to The Wireless Age or "The Wireless Experimenters' Manual," by Elmer E. Bucher, to each. Contest closes May 31st

An Improved Superdyne Six-Tubes

For Volume on Distant Stations It Is the Equivalent of a High-Priced Receiver

IN this improved six-tube Superdyne, the various tuning coils which comprise the antenna, inductance, the tickler coil and the plate reactance coil, are Curkoids (25 turns). The secondary and tickler coils are used in connection with the Curkoid dual coupler mounting—affording a very fine degree of adjustment of relationship. The coupling is adjusted by means of a worm gear arrangement controlled by a dial on the front of the panel.



One of the several types of superdyne receivers. This is a four-tube set made by C. D. Tuska Co.

The plate reactance coil which serves to increase the impedance in the plate circuit to the point of maximum regeneration is mounted on a fixed mounting, placed at right angles to the other two inductances.

The grid and plate tuning variable condensers may be of any good reliable manufacture. Their capacity is .0005 mfd. corresponding to the average 23-plate condenser. It is very important that these condensers have very low losses.

This receiver may be used with a loop, instead of an aerial and ground, by connecting the two terminals of the loop to the aerial and ground binding posts by placing a small fixed condenser in series with one side of the loop. A .00025 should be satisfactory.

Better results, however, may be obtained by grounding the negative side of the filament and connecting a small aerial, consisting of 15 to 20 feet of insulated bell wire strung across the room to the stationary plate of the first variable condenser.

In arranging the lay-out for this set it will be found that the arrangement in the circuit diagram will provide the shortest possible leads. It is well to remember that the leads which carry radio frequency currents must be very short and direct.

In wiring up the set the filament leads and other parts at more or less ground potential, should run nearer the front of the panel in order to prevent hand capacity effects. Also the variable condensers should have their rotor plates connected to the filament or ground side of the circuit and their stationary plates to the grid or plate or high potential sides of the circuit. This will almost eliminate any tendency toward body capacity effects.

Operating the Set

In the operation of this receiver everything depends upon the radio frequency stage. Great care must be used in constructing it, both in the placing of instruments and connecting them up. The main thing to remember is to hold the radio frequency tube from oscillating when both tuned circuits are brought to absolute resonance. It does not really matter which direction the rotor or stator is wound, as they can be shifted in the mountings.

Sometimes it will be found that reversing the lead to the coil and plate circuit will considerably change or affect the audibility of signals. The operation in general is apt to be a bit puzzling at first, so a few hints on the general manipulation of the dials will not be out of order.

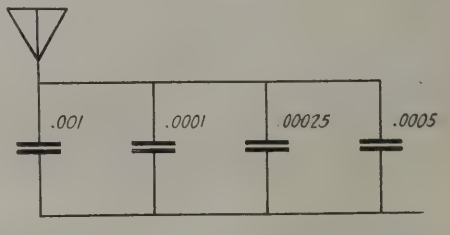
Set the resonating condenser, or rather the one which tunes the plate reactance, at about 20 and the wavelength dial at about the same, and advance the tickler coil from zero until a click is heard in the phones or loud speaker. This denotes oscillation. Work slowly on the edge of this point, coming forward with the resonating condenser and wavelength dials until the old familiar squeal of a station is heard. Tune this in at the loudest point and then reduce the stabilizer little by little and follow up with the resonating condenser keeping the squeal at a low tone until finally the squeal is entirely lost and the speech comes in perfectly clear. Then again adjust the wavelength dial for micrometer adjustment to further clear up the music or speech. Experience in tuning is necessary. Do not be discouraged if your first attempts are not successful, or if it does not come up to your full expectations the first time you try to tune it.

The parts used in this receiver are as follows:

Superdyne List of Materials

One special Curkoid Dual Coupler.
One special fixed mounting for Curkoid Inductance.
Three 50-turn Curkoids.
Two 23-plate .0005 mfd. Hammarlund Variable Condensers.
Seven Eby binding posts.
One 7″x26″ Bakelite Dilecto Panel.
One 7″x26″ Cabinet.
Two Paragon Audio Frequency Amplifying Transformers.
Five Bradleystats.
One Bradleyleak.
Five Freshman Fixed Condensers.
Six Na-ald Deluxe Standard Sockets.
One pair Modern Push-pull Transformers.
Three 7 Quinby Aluminum Frames.
One Warren Loop (this may be used instead of an outdoor antenna as mentioned in the text).
Two Weston Plugs.

Remember, of course, that you are at perfect liberty to select other parts of reliable manufacture and be as much assured of success.



Fixed condensers of the right capacity for the particular type of antenna used are to be preferred to using a variable condenser

The range of this receiver seems to be unlimited. With location in Chicago, it has been found easy to tune in western stations as distant as Los Angeles and Portland, Oregon, on the loud speaker without resorting to the head phones first, and the volume from KFI can be favorably compared with that of a phonograph. For volume on distant stations it is equivalent to any of the high priced sets on the market today. It is probably the most sensitive set known for the number of tubes used.

Trouble may be experienced with a suitable grid leak. This, you will note, with some tubes will have a tendency to block or choke when resonance is passed. This condition may be remedied by touching the finger tip to the grid terminal on the socket of the detector tube. However, if this becomes annoying it may be remedied by using a better grade grid condenser or using a grid leak, the latter being preferable.

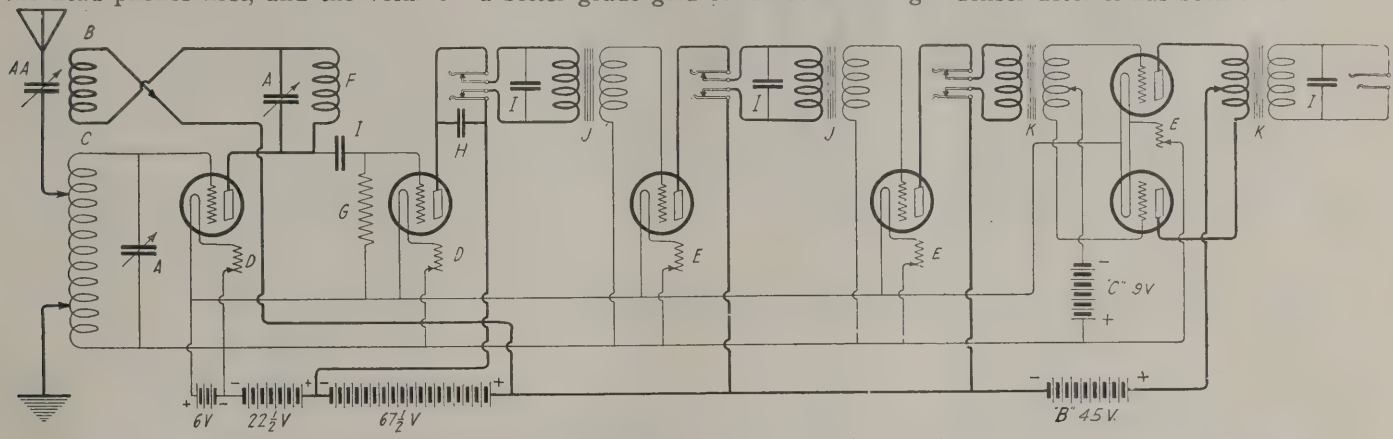
One very important thing to remember is never to connect a grid leak across the grid condenser. If a grid leak is needed it should be connected from the grid terminal of the detector socket to the negative terminal of the filament with as short leads as possible.

From 2 to 3 megohms will be found most favorable for use with tubes similar to the UV-201A. The grid condenser is .00025.

The best type of antenna to use with this receiver is a single wire about 70 feet in length, and 30 or 40 feet high.

Do not touch the wavelength condenser after it has been once tuned or balanced with the aerial, for this will throw the entire set out of tune. The position for this condenser must be found by experiment.

Very much care indeed must be taken in the wiring and selection of instruments. It is always best to select the very best instruments, and this is true economy, for eventually, the better grades must be installed.



Circuit diagram of the six-tube superdyne receiver described

"The Heart of Radio"

(*Continued from page 32*)

cessive and soon destroy the tube. In order to prevent the destruction of these power tubes in case the negative grid voltage supply should fail, the other voltages remaining at normal, a relay is provided which automatically opens the field circuit of the generators in case the negative grid bias voltage fails or drops below a certain value.

The right hand panel of figure 6 is the main controlling panel for the whole life testing equipment. In addition to the usual control switches, this panel includes an indicating voltmeter so that any marked variation in the filament voltage supply is easily noted and also a recording voltmeter in which there is kept a daily chart of the voltage fluctuation. This daily chart also gives a ready means of determining the hours per week during which the equipment is operated. The equipment is normally operated from 8 o'clock on Monday morning, continuously day and night, until 12 o'clock Saturday noon, being shut down over the week end. This gives a normal operation of 124 hours per week. This equipment requires the operation of five motor generator sets which are located in the basement of the building. These motor generator sets are among the group of machines shown in figure 7, which illustrates a portion of the laboratory power equipment.

The motor generator set furnishing the filament voltage supply has a complete automatic regulating equipment both on the motor and the generator so as to provide continuously perfect constant filament voltage.

At the present time there are approximately five hundred tubes on life test in this room. This represents a value of over $3,500 in tubes operated to full life solely in order to gain information as to their characteristics and length of life, and to help enable the factories to make better and better quality tubes.

The question is often asked: "What is the life of a certain model of Radiotron?" It is the purpose of this equipment just described, and which is installed and maintained at considerable expense, to answer this question and to answer it in the most thorough manner possible. The answer, however, is not a definite figure for any particular type of Radiotron, but information indicating how the life is changed by the many different conditions under which the tube is used. It is, therefore, incorrect to consider that every type of tube has a definite life figure. A slight variation in filament voltage greatly changes the life of the tube. It also varies depending upon the particular combination of filament, grid and plate voltage that is used. Because of the fact that nearly everyone operates a tube in a little different way and does not have accurate instruments for continuously maintaining the filament voltage at a certain value it is absolutely impossible to predict what the life of a tube will be in the hands of the user. The life of a Radiotron can no more be accurately determined than the life of an automobile. A certain automobile is delivered shiny and new from the factory. A few hours later it may be a wreck on the roadside or yet again it may have a long useful life and be finally relegated to a museum where it will serve a useful purpose for a century or more.

So it is with vacuum tubes. The actual life in the hands of the user can never be predicted, but it is the aim of the manufacturer to supply tubes of the highest possible quality so that if care is taken in their operation the life under the conditions of normal operation will be satisfactory.

A Summary of the Entire Subject of Amplifiers

Amplifiers

Amplification Without Distortion

Every kind of amplifier described with rules to guide the designer

By Louis Frank

PART I

Single-stage amplifiers. Resistance amplifiers. Inductance amplifiers. Tuned circuit amplifiers. Tuned Radio Frequency

To be continued in successive issues

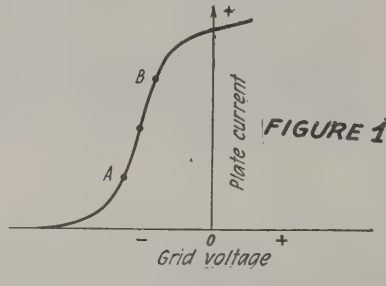
THE radio frequency energy collected by a receiving antenna depends upon a number of factors, but even in the best of cases is small. As a result it has been necessary in the past to increase the transmitter power to exceedingly large values in order to maintain communication with the receiving stations. The intensity of the received signal may be enlarged by amplifying the small received energy at the receiver and this is the common practice today since all broadcasting stations are operating on relatively low powers and it becomes absolutely essential to amplify.

Before the advent of the electron tube the only type of amplifiers available were the old Brown relay and the Telefunken sound intensifier. These produced at the best very small amplifications. In the case of the electron tube there was developed a device which has inherent in it large amplifying properties, and by the use of a number of tubes almost unlimited amplifications may be secured. At the same time the electron tube is capable of fulfilling one of the most important conditions of a good amplifier: namely amplification without distortion. So important is the entire subject of amplification that it may be considered the backbone of reception today. It is therefore the object of this article to summarize the entire subject of amplifiers, emphasizing the high lights of the subject.

Single Stage Amplifier

When a small voltage is applied to the grid of a three-element vacuum tube a large current will flow in the plate circuit as a result of the well known relay action of the tube. This large plate current may be made to flow through a high resistance or inductance placed in series with the plate, and across this resistance or inductance therefore, a voltage may be developed which may be many times greater than the originally impressed grid voltage. Or from the point of view of energy, a considerably greater amount of energy will be available in the plate circuit for operating, for example, a loud speaker, than is applied to the grid input of the tube. To secure this amplifying action the circuits must be properly designed.

Not only will a good amplifier amplify, if properly designed, but to be a



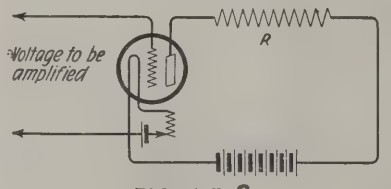


FIGURE 2

good amplifier it must fulfill one other important condition: It must produce in the output circuit of the tube an enlarged and exact copy of the signal impressed on the grid input circuit. This will only be the case if the plate current is always proportional to the grid voltage. From the general shape of the grid voltage-plate current characteristic of the tube, figure 1, it will be seen that this condition of direct proportionality is obtained over the small range of grid voltages where the curve is a straight line, namely between points A and B. Operation within this range can be accomplished by adjusting the value of the grid bias potential to a value midway between that of A and B. Thus our first design consideration is to operate the amplifier tube always with a negative grid bias, so that we work on the straight line portion of the characteristic curve thus securing amplification without distortion.

When the tube is operated under such conditions the amplification of the tube is constant, and is called the "amplification factor" of the tube, represented by μ_o. The amplification factor of a tube is one of the most important constants of the tube, for the actual amplification secured in practice depends upon it. The amplification factor of a tube is defined as the maximum theoretical amplification which may be obtained in the tube. Thus if (e) volts are applied to the grid, then the maximum possible volts which may be obtained in the plate is $\mu_o e$ volts. This maximum is never really attained, but it may be approached very closely in actual practice as will be shown. The maximum amplification which a tube is capable of giving, namely μ_o, depends solely on the construction of the elements and how they are placed relative to one another. Thus if the grid wires are placed close together, and are made very fine, the amplification constant increases, and if the grid is moved closer to the filament it will also increase.

As opposed to the theoretical maximum amplification factor of the tube μ_o, we have the actual or true amplification which is really secured in practice when the amplifier tube has a resistance or inductance in the plate circuit. This is called μ, and is in all cases less than the maximum factor μ_o. That it must be less will be evident from the following. For each volt which is applied to the grid there is developed inside of the tube in the plate circuit μ_o volts due to the amplification factor μ_o. Now obviously some of this amplified voltage must be consumed in the internal plate circuit resistance of the tube, leaving the balance of the amplified μ_o volts for the output. Thus the actual output must be less than the theoretical maximum amplification of the tube. It is the object of correct amplifier design, however, to make the voltage consumed inside the tube as small as possible, thus leaving most of the amplified voltage available for the output. We will now consider the actual design of the various types of amplifiers.

The circuit for such an amplifier is indicated in figure 2. In this case the amplified voltage is obtained across a resistance placed in the plate circuit. The question is what is the real amplification which can be obtained with this amplifier. This depends upon a number of factors, but assuming that we are working with a given filament current and plate voltage it depends upon the amplification constant, μ_o, of the tube, and upon the value of the

external resistance R. If we call the internal resistance of the tube R_ρ, then the total plate circuit resistance is $R+R_\rho$. It can be shown mathematically that the true amplification increases as the external resistance R increases. When the resistance R equals the internal resistance of the tube R_ρ the actual amplification obtained is ½ of the maximum possible amplification μ_o, for obviously half of the voltage will be consumed in the plate resistance of the tube. If we make the external resistance R less than that of the tube then the real amplification will decrease below $\frac{1}{2}\mu_o$. If we increase the value of R then the real amplification will increase, and it increases according to the curve of figure 3, which shows real amplification against the external resistance R. From this curve it is seen that the practical maximum true amplification, where the curve begins to flatten out, is obtained only if the load resistance is several times higher than the plate resistance of the tube, say about three times as great. Thus for the type of tubes on the market today like the UV-199, UV-201A, etc., which have plate resistances of about 20,000 ohms, it is desirable to have over 50,000 ohms in the plate.

It would appear that the more we increased the value of the external plate resistance R the more true amplification we would get. However from figure 3 we see that while this is so the actual increase in amplification after point A is reached is very small for the greatly increased value of resistances. In other words we have here reached the practical engineering limit. However there is another drawback to actually increasing the value of the resistance R.

One-Step Resistance Amplifier

The amplification of a tube depends upon the plate voltage actually applied to the plate. Now if we have a constant plate battery voltage it is evident that there must be a drop of voltage across the external resistance R. Thus only part of the plate battery voltage is applied to the plate. The greater the resistance R the greater will the drop across it be, and the smaller will be the actual voltage applied to the plate, thus decreasing the amplification obtained. If we wanted to keep the effective voltage on the plate constant irrespective of the external resistance R we would have to increase the plate battery voltage as we increased R, in order to counteract the voltage drop across R. This is very costly, hence there must be some limitation to the increase of the external resistance R. For these reasons in actual amplifier design it is not desirable to go beyond about three times the tube resistance for the value of the external resistance R. Thus for the 20,000 ohm tubes at present on the market a suitable value for R is about 50,000 to 60,000 ohms.

The circuit for this amplifier is indicated in figure 4, in which it is seen the amplified voltage is developed across an inductance in series with the plate circuit. In general the resistance of this inductance is much lower than its reactance at the frequencies employed and it may therefore be neglected. In such an amplifier the true amplification is directly proportional to

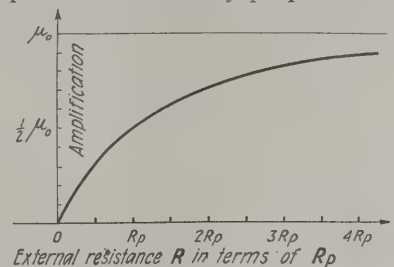


FIGURE 3

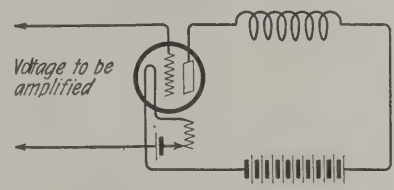


FIGURE 4

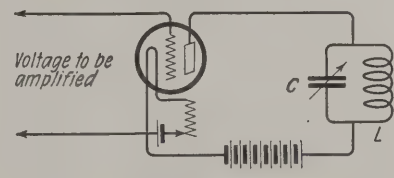


FIGURE 5

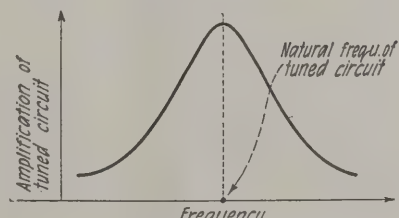


FIGURE 6

the reactance. The larger we make the reactance the greater is the true amplification obtained. Hence by making the inductance L very large we can approach the theoretical maximum amplification very closely. This type of amplifier will give higher amplifications in general than the resistance amplifier above described. For the inductance L is an iron core inductance, and its resistance is therefore very low compared to its reactance. Thus there is a very small direct voltage drop in it, hence the entire plate battery voltage is effective on the plate of the tube. In using inductance coupled amplifiers care must be taken to prevent saturation of the iron core, for direct current flows through it and magnetizes it. If it becomes saturated distortion will occur. There are just two practical ways to avoid this. The first is to use an inductance having an iron core with very large cross-section, so that the small plate current will create only a very low flux density. This precaution need be observed only if the inductance is a closed core affair.

One-Step Inductance Amplifier

The second way to avoid distortion due to saturation of the iron core is to use an open core inductance, or a closed core inductance with a small air gap. The small air gap or open core effectively prevents saturation. The exact value of inductance to use for maximum amplification is not very critical but should be about two times the value of the internal plate resistance of the valve at the lowest frequency used. To illustrate by means of a practical example, suppose you desire this amplifier for receiving broadcasting. Then we may consider the lowest frequency received as about 50 cycles, since music ranges in frequency between 50 cycles and 10,000 cycles. At 50 cycles the reactance of our inductance should be at least twice the internal resistance of the tube, which for the usual type of tubes as the UV-199 and UV-201A is 20,000 ohms. Thus our reactance should be about 40,000 ohms at 50 cycles. Since reactance is given by the simple equation:

Reactance $= 6 \times$ frequency $\times$ inductance $= 6fL$, we have

$40{,}000 = 6 \times 50 \times L$

therefore inductance $= L = 133$ henries.

For the frequencies higher than 50 cycles the reactance will be greater, hence the amplification may be somewhat greater at the higher frequencies, so that it is seen that no loss of amplification is thus secured.

One Stage Tuned Circuit Amplifier

In this type of amplifier a tuned radio frequency circuit is used as in figure 5, and the amplified voltage is developed across the tuned circuit. In general this circuit is a radio frequency circuit and can therefore only be used for radio frequency amplification. If an analysis is made of the impedance of this circuit it will be found that to currents of the same frequency as its natural frequency it offers the maximum impedance. Hence for any given current value the maximum voltage will be generated across the circuit at its natural frequency. At this natural frequency, or resonant frequency of the circuit, the circuit behaves like a pure resistance whose value is given by the simple equation

$$R \text{ effective} = \frac{L}{CR}$$

(*Continued on page 68*)

Sun Spots and Radio

Prominent Radio Engineers Refute Astronomer's Theory

PROFESSOR MORECROFT, Dr. Goldsmith and John V. L. Hogan, knowing that The Wireless Age is at all times primarily concerned with publishing authoritative material, submit their statements which are designed to impress our readers with the importance of understanding the profound difference between a theory and a basis of fact. With due respect to Professor David Todd, the three prominent engineers point out that his theory of Sun Spots and Radio is only a theory, unsupported by sufficient evidence of proof and that, furthermore, static will not interfere whatever with our mid-summer's radio.

Letters to THE WIRELESS AGE from

Dr. Alfred N. Goldsmith

Chief Broadcast Engineer, Radio Corporation of America

tells "The Wireless Age" readers that the coming summer will give us plenty of radio enjoyment.

To the Editor:

An investigation of electrical disturbances of radio reception discloses the remarkable irregularity of the effects observed and demonstrates the difficulty of predicting the strength of electrical disturbances (static) at any future time.

As a general rule, static is least in the early morning and in the cold winter months. On the other hand, there are sometimes very severe periods of static at night and even in the coldest weather.

Static varies from year to year, sometimes being unusually weak for several years in succession and sometimes being strong one year and weak the next, and so on.

Then too, there are some years when static is sharply "bunched" during a given limited portion of the year, the remainder of the year being relatively free from static.

Many theories have been advanced to account for static. Lightning storms, electrical currents in the upper layers of the atmosphere, electrical bombardment of the upper atmosphere, earth currents, and changes in the magnetic condition of the earth have all been suggested as possibilities. Presumably, any imaginative geologist, meteorologist, or astronomer could evolve a goodly volume of fairly plausible theories based on his specialty.

But to correlate such theories with the systematically observed facts over a long period of time is quite another matter. In the first place, an enormous volume of information has to be experimentally gathered and this information must then be statistically analyzed. In the second place, effects must be predicted on the basis of this theory and the effects actually found to occur as predicted.

So far as radio engineers are concerned, neither of these requirements has yet been successfully met; and consequently, interesting as any particular theory may be, it cannot be regarded as more than a pleasantly suggestive and stimulating thought.

Professor J. H. Morecroft

Columbia University, President of the Institute of Radio Engineers, Consulting Engineer, New York City

says we cannot predict static conditions from present established data.

To the Editor:

There is no doubt that radio will continue to furnish us instruction and entertainment during the summer months as it has during the winter.

The connection between certain variations in the earth's magnetic field and the presence of spots, or storm centers, on the sun seems to have been reasonably well established but, in so far as I know, there is no proof at all which shows a dependence of our enemy static upon the changing magnetic condition in the earth so brought about. It seems quite likely that such a connection does exist, but it may be so slight as to be negligible. Quite likely the atmospheric disturbances which cause us most of the trouble classed under the head of static are of terrestrial origin. Although much less violent in character than are the sun's, our earthly storms are so much closer that their effect on radio receiving sets may be incomparably greater than is that of the sun's storms.

What then about the coming summer with the predicted prevalence of large, well-defined sun spots? Shall we be so disturbed by these solar turbulences that listening will constantly remind us of frying eggs, in the sputtering spider? We have no reason at all to believe so. The coming summer will give us as much, or more, enjoyment from radio than have its predecessors. The change in activities which the reasonable listener will develop as the summer advances, will be due to calling in his first lines of attack. Instead of listening to stations thousands of miles away, which naturally send to him very weak signals, so weak in fact that they are well buried in static, he will deign to listen to stations nearer home, which because of their nearness, will put at his disposal signals much stronger than the atmospheric disturbances, signals which will therefore be free from objectionable noises to a degree sufficient to make radio listening still a worth-while manner of spending the evening.

John V. L. Hogan

Fellow and Past President, Institute of Radio Engineers
Member, A. I. E. E.

protests that broadcasting was successful in the summers of 1922 and 1923 in spite of atmospheric conditions.

To the Editor:

May I suggest that Professor Todd's prediction carries with it a number of unsound implications? To say, as he does in the April number of your magazine, that "during the coming year radio reception will be most difficult because of heavy static discharges" is necessarily to be misunderstood. Perhaps a careful reading of his entire article, coupled with a knowledge of radio transmission phenomena, would allow one to assign a proper weight to the bare statement that I have quoted. I fear, however, that many of your readers will be led astray by the brevity and positiveness of the prediction, and that they will consider it certain that static will prevent effective broadcast reception this summer. Hence this letter.

The fact is that any prediction as to static is unsafe. We know too little about its origin and causes to warrant any prognostications. Professor Todd may be certain that we shall have unusual solar disturbances, but even if we do there is no certainty that static caused by them will prevent radio transmission. We have the proof of this in Professor Todd's own statement that sun spot activity which broke up transatlantic cable service did not produce static strong enough to interfere with transatlantic broadcasting!

In the spring of 1922 most radio engineers feared "summertime static." When the summer of 1922 was over, they commenced to wonder why so little static disturbance of broadcasting had been observed. Some pessimists insisted that it had been an especially good summer for radio, and said "Wait until *next* July!" But the summer of 1923 disappointed them again, for good broadcast reception was possible right through the hottest months. There is no real reason to expect the summer of 1924 to be any different.

The main technical reason that broadcasting keeps on performing satisfactorily in the summer months is that the transmitters generate powerful continuous waves of high frequency.

Whittemore builds

A RADIO HOME

Government's Radio Engineer plans a home with a complete radio installation

By S. R. Winters

ARCHITECTURAL plans for the building of many homes in the future will make specific provision for the convenient wiring and installation of radio-receiving instruments. Not unlike facilities for a shower bath, the folding bed, electric-light fixtures and the coal bin, the blueprints of the architect of tomorrow will include a systematic plan for installing a radio-telephone receiving set. This foresight in the building of residences will not only recognize radio as an integral unit among the conveniences of modern homes, but will contribute to the pleasing arrangement of the installation of such apparatus.

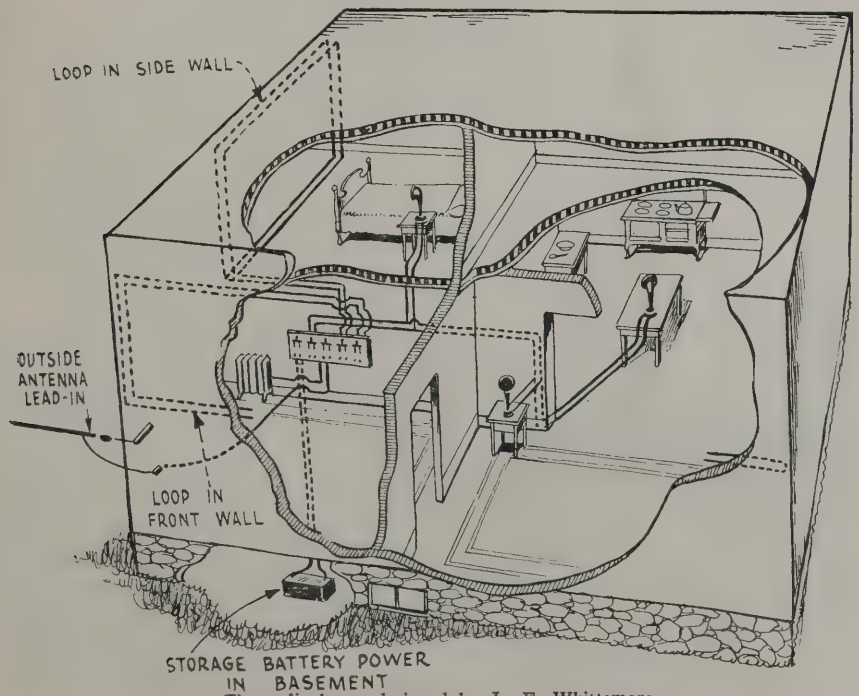
Fortunately for the popularity of the inclusion of radio facilities in the specifications of the architect, L. E. Whittemore, formerly alternate chief of the Radio Laboratory of the Bureau of Standards, but recently appointed secretary to the Governmental Interdepartment Radio Advisory Committee, is among the first if not the first, to make specific provisions for the installation and arrangement of radio instruments in his home. The 7-room house now being constructed for Mr. Whittemore at Edgemoor, Maryland, about eight miles from the heart of Washington, is being erected according to original plans contemplating the convenient and pleasing arrangement of loop antennas, batteries, loud speaker and other units for the reception of radio communications.

Of course, the facilities for installing the radio equipment will be largely devised by Mr. Whittemore. However, the contractor who is building his suburban residence has been instructed to lay a conduit from the basement, where batteries will be placed, to the second floor of this home, thus obviating the unsightliness caused by ordinarily depositing the batteries under the cabinet or table on which the receiving instruments proper are mounted. Wires from the second floor to the first floor will connect with a loud-speaking device, which can be operated when a group of persons desire entertainment, information or other intelligence borne on the invisible electro-magnetic waves.

The study of Mr. Whittemore, which he modestly describes as his "den," will be on the second floor of his residence where the radio-receiving instruments will be installed. The latter will be placed on book shelves which may be closed, thus hiding from view any unseemly mechanism. The terminals for the antennas and those of the receiving set will be brought together in one plug board. The lead-in wires from an overhead antenna will come from a nearby tree and pierce the walls of the home to the antenna plug. In addition to an outside antenna, Mr. Whittemore has installed two large loop antennas, comprised of single turns of wire at different sections of the walls. The use of two loops, situated at different angles, will enable the operator to readily avail himself of the directional characteristics for reception, a peculiar virtue of a loop or coil of wire.

L. E. Whittemore

This "radio home"—if this term is permissible—owned by the secretary to a government committee in which is reposed the administration and regulation of radio among the various government departments as well as the exercise of a profound influence on radio broadcasting and commercial traffic, should serve as an example for popular duplication. Mr. Whittemore, in his former capacity as alternate chief of the Radio Laboratory of the Bureau of Standards, was among the vanguard in the development of this science. Therefore, his judgment in modifying the blueprints of the home-building architect to make specific provisions for radio installations carries with it a prestige and scientific knowledge that deserve widespread emulation and as a result it is not unreasonable to assume that "radio homes" will become increasingly popular in the near future.



The radio home designed by L. E. Whittemore

The article on the construction of a super-heterodyne which it was announced would appear in this number was not completed by the time of going to press and had therefore to be omitted.

Peeps Into Broadcast Stations

Olive Ann Alcorn, dancer, late Winter Garden star, giving her talks on dancing from WFI

Hot Hoot Owl Stuff

BROADCASTING Station KGW, out in Portland, Ore., tries to shape its programs so that in the course of a week every kind of listener, regardless of his tastes will have some entertainment that particularly suits, but the one weekly program that seems to suit all is the meeting of the "Keep Growing Wiser Order of Hoot Owls." One clerk is kept busy on "Hoot Owl" mail all the time and during a meeting two telephones and a telegraph loop are kept constantly busy.

The "Hoot Owls" do not sound like regular radio stuff. They sound as though there was a dandy party going on in the next room and somebody had left the door open. Of course, it is all carefully staged, more so than a regular concert, with every minute of the two hours carefully scheduled, but the general effect is as though it were all haphazard and pure fun. The degree team is made up of the best wits in town, one merchant, one lawyer, a wholesaler, a piano dealer, the owner and manager of a booking service and an insurance man; also the manager of KGW and a goat that is always heard, but never seen.

The "Hoot Owls" always come on the air with an orchestra overture, the "Hoot Owl" song, the first and only regular announcement, and then the meeting is turned over to the grand screech who calls the roll and starts the fun. The first order of business is the initiation and the ride on the goat. From then on it is frolic, music and *ad lib* wit. All solos are put on with orchestra accompaniments and sometimes two orchestras and six singers besides the degree team are introduced.

One member of the degree team started to tell a story one night. He was promptly stopped by three other members. Ten minutes later he tried again and got a bit further—there was a blonde opposite the traveling man in the Pullman car—before he was stopped. A third attempt brought him to where just as the porter turned his back. He tried for four meetings to tell that story, but the degree team or the orchestra always drowned him out. The mail doubled and every other letter was an urgent request or a demand that he be allowed to finish. Threats, bribes and mandates came in galore. One old woman came to the studio to see what the place looked like, ostensibly, but before leaving she asked the secretary in a whisper if she couldn't hear the rest, but the story has never been finished.

Lots of requests come in to broadcasting stations to have certain people sing or play, but so far as Dick Haller, manager and director of KGW knows,

Richard V. Haller, announcer and director of KGW

he has only one group so popular that the listeners kick when they are not on the program at a "Hoot Owl" meeting. This group consists of Helen Lewis, Kathleen Duffy and Ruth Meade, all of whom sing and play at least one instrument each. They've never been known to pull a flop, nor have they ever given the audience all it wanted.

Women aren't allowed in the "Hoot Owls." Men and boys who listen are entitled to membership cards and they are issued by the thousands. The degree team, those who put on the programs, is a closed organization, requiring a unanimous vote from the others on the team for admittance and each man must be talented in some way to be eligible. There is at present a long waiting list with a full-fledged bishop at the top.

The St. James Choir of male voices broadcast from WEAF

Lady Martin Harvey Startles CKY Listeners

QUITE a sensation among radio listeners was created by Lady Martin Harvey's address at Central Congregational Church, Winnipeg, broadcast by CKY. The eminent actress denounced alleged activities of the communists among children and made statements which were warmly contradicted by several listeners who telephoned the broadcasting station. The responsibilities of broadcasters for remarks made by speakers during

church services or on public platforms has not yet been defined. To make broadcasting authorities responsible for opinions expressed by speakers would surely be to impose hardship tending to restrict freedom of speech and to curtail the use of radio. Many excellent sermons and addresses would never have been heard had the broadcasting director been expected to insist on their being written out in advance and censored.

Moving a Broadcast Station

IT took only one concert, broadcast from the new studio of WJAX, to prove to the Union Trust Company, which owns and operates this station, that WJAX was getting out over the entire country from its new station just as successfully, and perhaps more so, than from its old location in the Citizens Building.

The new studio is located upon the twentieth floor of the new twenty-story Union Trust Building, the largest bank and office building in Cleveland, which is shortly to be occupied by the Union Trust Company itself.

The moving of the broadcasting station to the new building was simply the forerunner of the moving of the entire bank.

During the process of moving, prize contests were arranged so that immediately after the new station was ready for business, announcements were broadcast. The prizes amounted to well over $1,000, which was offered by Cleveland radio dealers and manufacturers to determine what distance was reached by the new station, as well as clearness of reception. Replies were received from Miami, Florida, and points in the extreme west.

Virginia and Maxime Loomis, two tiny Movie Stars appearing at KFI

Speaking of Bears

FROM the land where wild game is still plentiful has come a request to WGY, the Schenectady, N. Y., radio broadcasting station, that child-eating bears be deleted from bed-time stories for the children. In a country where bears are a frequent sight such stories, it is explained, put fear in the hearts of children.

The letter came from F. J. Lee, a resident of Lee Valley, seven miles from Massey Station or New Ontario, Canada. Mr. Lee is the first settler of the place which is named after him. He is well over seventy years old and has lived at Lee Valley for thirty years.

"I want to file a protest," writes Mr. Lee, "against the bedtime stories for the children about bears eating up little boys or wanting to. Remember that stuff goes to this new country where there are bears. There are few children going to school who haven't seen a bear."

Paul Whiteman and his world famous Palais Royal Orchestra broadcasts from WEAF

Best Bets in Humor

'S Matter Pop?

IT WOULD BE A GOOD THING IF YOU LIVED IN A CITY WHERE THERE WERE NO BROAD CASTING STATIONS!
AHA! AT LAST YOU BEGIN TO TALK LIKE A REAL RADIO FAN
?
MAW YOU SPEAK OF A PARADISE
WHERE THERE WOULD BE NO INTERFERENCE AND NOTHING TO DO BUT TRY FOR DISTANCE!
SMATTER MAW?
3-26
(Copyright, 1924, by The Bell Syndicate, Inc.)

—*N. Y. Sun.*

In Deep

Smith—"It must take a lot of money to follow the radio craze. I hear you have a new outfit—what kind of receivers are you going to have?"

Smythe—"I don't know. The court hasn't appointed them yet."

—*American Legion Weekly.*

Befuddled Radio Enthusiast—"Been waiting for over an hour—when does that concert commence?"

—*Life.*

Eclipsing the Ancients

By William Harvey Bradfield

Methuselah, Methuselah,
He lived three thousand years ago,
And 'cause he died in early youth,
Knew naught of Radio.

He never had a crystal set,
Much less a Neutrodyne;
He never heard "The Cat" announce
Nor knew the ether's whine.

Cleopatra, Egypt's queen,
Though hemmed around with wealth,
Could never listen in at night
For hints upon her health.

King Solomon, so wondrous wise,
And wed a thousand times,
Could never dance around his house
To South Sea Island chimes.

So, though the ancients had their fun,
Their wealth, their slaves, their glory,
We fellows with a home-made set
Have got 'em skinned, begorrie!

A Misnomer

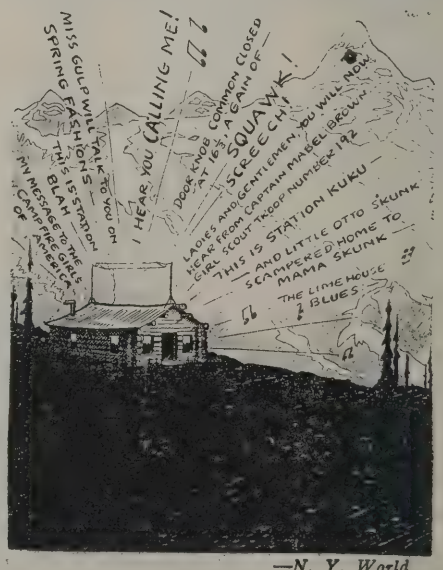
It is indeed a cynic who refers to radio as *wireless* after winding coils, connecting parts and putting up the aerial.

S O S!

A sailor has no EZ time,
When on the DP sails.
It's RD finds, aloft to climb,
Exposed to IC gales;
And then in KC makes a slip,
Or if he DZ grows,
A tumble off the RD ship,
And into the CE goes.

—*Life.*

Solitude **By H. T. Webster**


I HEAR YOU CALLING ME!
MISS GULP WILL TALK TO YOU ON SPRING FASHIONS
THIS IS STATION BLAH
AN MESSAGE TO THE GIRLS OF CAMP FIRE AMERICA
DOOK NOOK COMMON CLOSED AT 16½, A GAIN OF
SQUAWK!
SCREECH!
LADIES AND GENTLEMEN, YOU WILL NOW HEAR FROM CAPTAIN MABEL BROWN OF GIRL SCOUT TROOP NUMBER 192
THIS IS STATION KUKU
AND LITTLE OTTO SKUNK SCAMPERED HOME TO MAMA SKUNK
THE LONE HOUSE BLUES

—*N. Y. World.*

Mutt and Jeff—Yes, Ain't Science Wonderful **By Bud Fisher**

SIR SIDNEY'S A SMART MAN! HE TOLD ME TONIGHT THAT SCIENTISTS HAVE PERFECTED A RADIO BROADCASTER THAT'S SO DELICATE IN IT'S MECHANISM THAT YOU CAN HEAR AN INSECT'S HEART BEAT OVER THE RADIO!
HE TOLD ME HE HEARD A FLY WALKING ON A RUBBER PAD EASY AS PIE OVER HIS RADIO LAST WEEK! WE'RE LIVING IN A GREAT AGE!
EEP-EEP-EEP EEP-EEP EEP
WHAT ARE THEY BROADCASTING, MUTT?
DARNED IF I KNOW! SEE IF YOU CAN TELL WHAT IT IS!
M-M! SOUNDS TO ME LIKE A FEMALE FLEA CALLING TO ITS YOUNG!
EEP-EEP EEP-EEP EEP
OOWAH!
EEP

—*N. Y. World.*

Königswusterhausen

By Dr. Albert Neuburger

German Correspondent
For The Wireless Age

IN its development the great wireless station of Königswusterhausen near Berlin forms an interesting experiment. It shows in a work of many years how the great arc-generators have been created. The sending energy for this giant station is now used for wireless telegraphy as well as for telephony.

Let us pursue the growth of this station.

The first and for ten years also the only applicable system for generating continuous electric oscillations, was invented by V. Poulsen in 1903. Wireless telephonic communications over short distances were already demonstrated by Poulsen in 1904. When the German Poulsen patents were offered to the C. Lorenz Aktiengesellschaft in 1906, this firm recognized that during the next years it would be possible only by means of this system to telephone by wireless. Consequently this firm devoted itself for a long time in the construction of wireless sets, fitted out for radio telephony.

Since 1910 radio telephony was practically used for military and naval purposes; i. e., only by the Lorenz-Poulsen system. That nothing was known about this matter for so long a time, is only because the monopoly of using radio telephony had been conceded to the German Navy. The reasons for keeping this system a secret having disappeared, it is now possible to publish an account of the development of the Poulsen arc system.

As can be seen, the development of the arc-generators used in Königswusterhausen was influenced by the endeavor to create and to perfect a system of wireless telephony. While in other giant stations wireless telegraphy was used for communication, this was done at Königswusterhausen by telephony. Now this station serves, as has already been mentioned, for telegraphic transmission as well as for the telephone service.

Aside from the arc-generators it may be mentioned that there are other methods of producing high frequency electrical oscillations of a continuous character; i. e., oscillations of constant amplitude. These methods are the high-frequency generator, the tube, and the arc-system.

While the high-frequency generator system is based upon the tendency to generate high-frequency oscillations for radiotelegraphy directly from generators, and while in the tube transmitter system triodes serve to generate oscillations, there is used in the arc-system a direct current arc which is able to charge and discharge a condenser circuit in rhythmical succession.

The Danish inventor, Valdemar Poulsen, in order to transform direct current energy to high-frequency energy caused a magnetic field to act upon the arc and made the arc glow in an atmosphere of hydrogen and thus devised the practical use of the arc transmitter in wireless traffic.

The arc itself was generated between two electrodes, the positive one of which is made of copper while the negative one consists of coal.

The coal electrode is turned round its axis by means of a special motor so that fresh points of this electrode are always burnt. In this way not only the coal is burning uniformly, but also the arc is always of the same length.

The building that houses the transmitting apparatus

The connection of Poulsen transmitters is either direct or intermediate circuit connection. For the radiation of the oscillations produced by means of the arc both ends of the lamp are connected to the aerial and to the earth (direct connection) instead of the inductance and capacity of the closed circuit. In the other case the aerial, by means of a coil, is coupled to the inductance of the closed circuit (intermediate circuit connection).

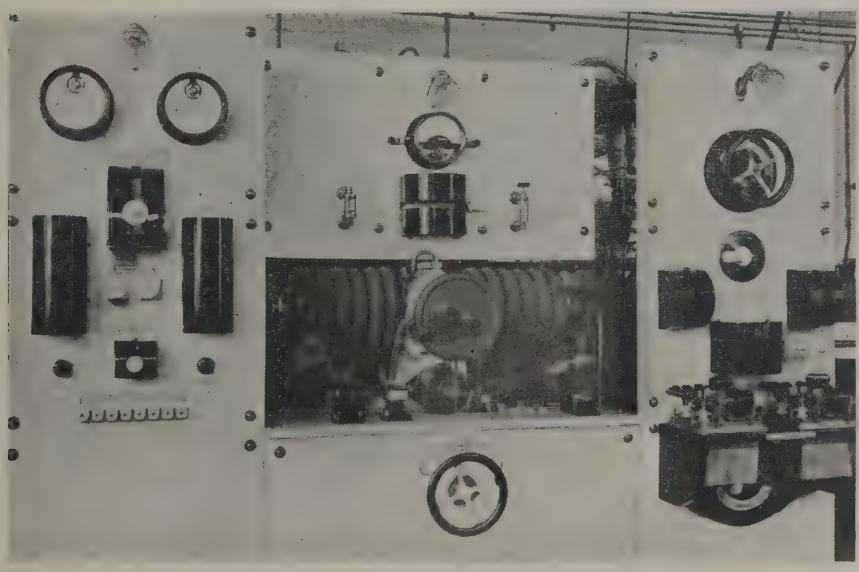
As distinguished from spark transmitters it is not possible to operate with the working current absorbed by the arc for the purpose of radiating the energy in the sense of Morse inkwriter signals, because the arc would be much disturbed or totally quenched. If the ignition were renewed again and again, apart from other difficulties in transmitting, speed would be slackened.

In the service until now two methods of operating have been used, one of which is based upon detuning the aerial in so far as a second wave, a so-called detuning (or "back wave") is sent out during the intervals between the signals.

These are the principles of the arc system in which a good many improvements have been made during the last years by the Lorenz Company and especially by its engineers, Dr. Gerth and Dr. Pungs.

The Lorenz-Poulsen sender of today has two rotary electrodes. By making both electrodes rotate and by replacing the copper electrode by a second coal electrode, the constancy of oscillations is guaranteed so that a good heterodyne reception is possible. The arc noises which formerly had been noticed are totally removed.

(*Continued on page 60*)



Control panel of the Königswusterhausen radio station

RADIO NEWS FROM ALL OVER THE WORLD

Broadcast Reception on Moving Trains in England and America

THE possibility of listening-in and connecting up with the chief broadcasting stations in the country while traveling by train at a high speed, by means of an indoor aerial, has been established.

A six-tube set was recently installed in a train of the English Great Western Railway. Connection was at once secured with the London broadcasting station, and was maintained throughout the whole of the journey.

Forty miles from London, and at a speed of eighty miles an hour, the results were surprisingly good, being clearly heard from a loud speaker above the noise of the train. Sixty miles from London, there was no diminution in the strength of the reception. At this point a change over was made to pick up Birmingham, and this was accomplished. Later tests in the use of head phones and in getting other stations were equally successful.

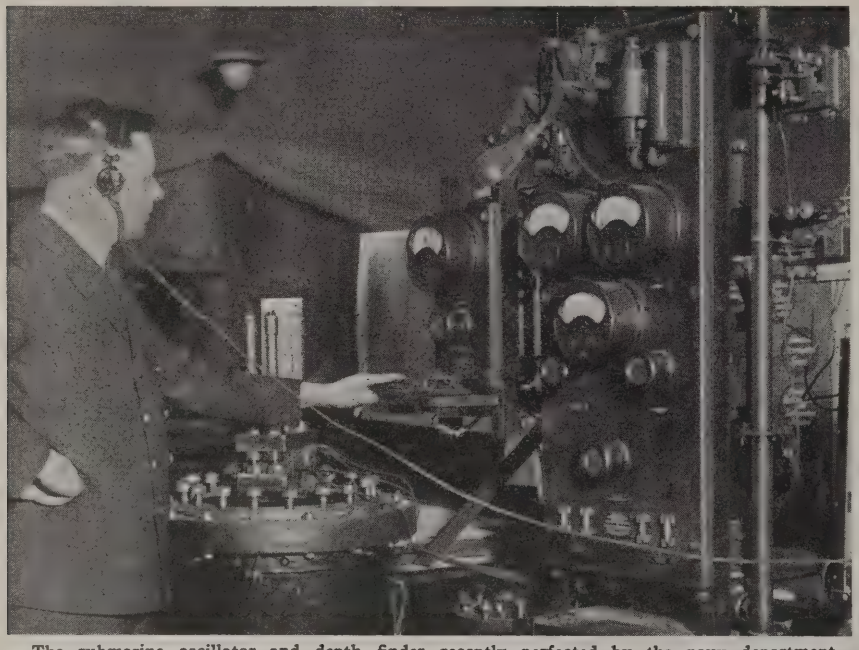
Delegates to the Convention of the Telephone and Telegraph Section of the American Railway Association recently held at Colorado Springs were able to try out the great possibilities of radio on moving trains. The special train bringing delegates from Chicago was equipped for radio reception with a seven-tube heterodyne. The aerial consisted of two wires stretched the full length of the car on either side of the roof. The ground was made to the car water system.

The train left Chicago about ten in the morning and reception continued good throughout the day and evening. The next morning, Sunday, the delegates attended church and took part in a service three hundred and fifty miles away.

Many interesting phenomena were recorded during the trip. Whenever the train passed through a cut approximately as high or higher than the car, the signals were somewhat decreased in intensity, but immediately returned to normal strength when the car emerged from the cut. Sand or stone seemed to have approximately the same effect so far as the observers could tell.

Iron bridges and steel frame buildings, or heavy power, telephone and telegraph pole lines produced the same effect in a greater or lesser degree. On the other hand, passing trains did not appear to produce a noticeable decrease in signal strength.

The most pronounced effect of shielding was observed as the train crossed the Mississippi at Davenport while the Palmer School was sending. Between the steel spans, the signals increased in strength momentarily, but as the train passed between the steel girders, there was a weakening and the signals were almost inaudible with the amplification used.



The submarine oscillator and depth finder recently perfected by the navy department

Neutrodyne Royalties in Dispute

THE Hazeltine Research Corporation has brought suit against the Freed-Eisemann Radio Corporation in the Eastern District Court of Brooklyn.

The Hazeltine Corporation collects royalties on all neutrodyne receiving sets, which are designed in accordance with the neutrodyne principle invented and patented by Professor L. A. Hazeltine of Stevens Institute of Technology. This corporation sought a temporary injunction against the Freed-Eisemann Corporation which manufactures neutrodyne receivers.

The motion was denied by Judge Ince, who ordered the Hazeltine Corporation to return to the Court all royalties paid them by the defendants, pending a further hearing, which is set for June 7, 1924.

At the same time the Court accepted the offer of the Freed-Eisemann Corporation to place in the hands of the Court the full amount withheld by them awaiting adjudication.

The Freed-Eisemann Radio Corporation contend they should pay royalties on certain patented parts only while the Hazeltine people demand royalties on the complete receiver.

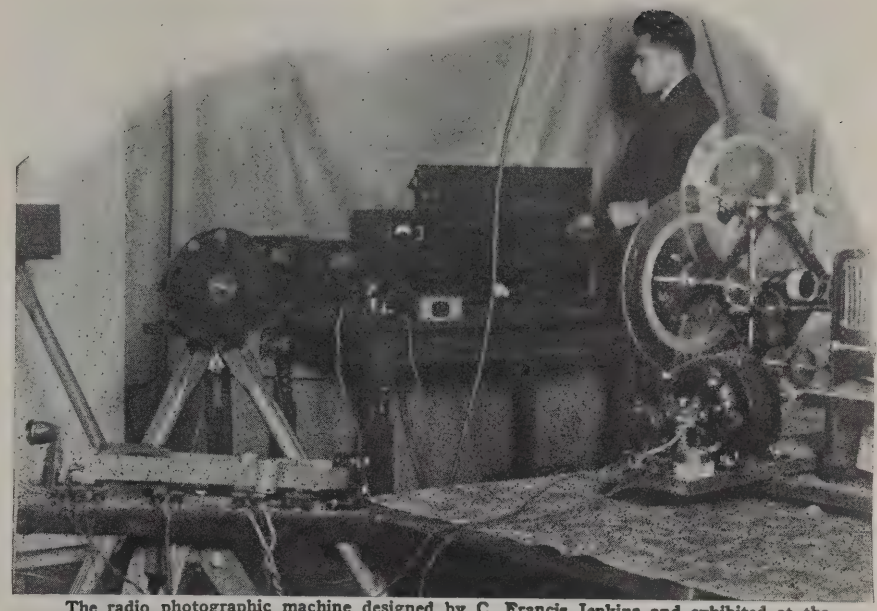
The defendants also charge fraud on the part of the law firm of Pennie, Davis, Marvin and Edmonds, alleging that, when the Freed-Eisemann Radio Corporation contract was signed, the lawyers who represented both parties held stock in the Hazeltine Research Corporation without disclosing this fact to their clients, the Freed-Eisemann Radio Corporation.

Austrian Chancellor Inaugurates Radio Service Between London and Vienna

DR. SIEPEL, Austrian Chancellor, in his address on the occasion of the inauguration of the wireless service between London and Vienna, presented a vision of the great future world-service of radio which is full of promise. His hopes for radio are embodied in the following extract from his address.

"One would not fully appreciate the most modern means of communication —wireless telegraphy—if one only attributed to it an importance in the economic life of the nations. Its extreme importance is confirmed by the fact that the means of entente between nations have in wireless a particularly efficacious acquisition. The interests which divide nations are rarely material. If the nations knew one another better they would understand and appreciate one another better. Let us hope that wireless telegraphy and telephony will perform wonders in this direction and will contribute to abolish not only distances in space, but also moral distances. One of the greatest inventions of modern science would thus serve the end aimed at by the League of Nations. We Austrians have learned for our salvation that the League of Nations is an effective instrument for the entente between the nations, and we are very anxious again to express our thanks, and at the same time the wish that the irresistible waves of good will and international unity will find in the near future the way to the heart of all nations both near and far."

The radio receiving loop of the giant S.S. Leviathan



The radio photographic machine designed by C. Francis Jenkins and exhibited at the Washington, D. C., radio show

Prominent Engineers on Radio Standardization Committee

PRESIDENT J. H. MORECROFT, of the Institute of Radio Engineers, has appointed the following as members of the Standardization Committee of the Institute for the year 1924-25: E. H. Armstrong, L. A. Hazeltine, A. N. Goldsmith, J. V. L. Hogan, J. H. Dellinger, C. A. Hoxie, A. E. Reoch, L. W. Chubb, H. W. Nichols, F. H. Kroger, R. F. Gowen, L. E. Whittemore, Bowden Washington and Capt. Guy Hill. Donald McNicol is chairman of the committee.

A book of definitions of radio engineering terms was published by the Institute in 1922 and the work of the new committee is to bring this important work up to date in view of the many forward steps which have been made in the art of radio since then.

Transcontinental Radio Chain Established

ARRANGEMENTS have been completed for the establishment of stations in five cities in Western Canada. There remains only Vancouver to complete the transcontinental chain of radio stations that will make the Canadian National Railways. Arrangements for the establishment of stations in Winnipeg, Saskatoon, Regina, Edmonton and Calgary have been completed.

These stations are not new, like CKCH in Ottawa, but are stations already existing with which the Canadian National Railways have come to agreement for the broadcasting of programs. In Winnipeg, the Manitoba Government telephone station CKY, using the 450-meter wave length, will broadcast every Thursday evening; from Saskatoon the radio supply station CFQC will broadcast every afternoon between 3 and 4 o'clock; from Regina, station CKCK, 420 meters, will broadcast each Tuesday evening; from Calgary, station CFCN, 440 meters, will broadcast every Wednesday evening, and station CFAC, 430 meters, every Thursday evening; from Edmonton, station CJCK, 450 meters, will broadcast every Friday evening.

Radio Shows

ARRANGEMENTS have been completed to have the first annual International Radio Show, Sept. 22 to 28, at Madison Square Garden. It will be held under the auspices of the Radio Manufacturers' Show Association.

A similar show will be held Nov. 18 to 23 in Chicago at the Coliseum. A ten-year lease has been taken for Madison Square Garden and the Chicago Coliseum, as it is planned to stage the show each year.

One of the features of the exposition will be an Amateur Builders' Contest, divided into three classes as follows: High school boys, grade school boys and the third for girls.

Radio in South Africa

IN Cape Town at the present time there are three amateur stations who indulge in experimental transmissions, on 200 meters namely: AIA (J. S. Streeter, Esq.), Thursdays, 8 P. M.; AIV (B. Jeffs, Esq.), Tuesdays, 8 P. M.; AIQ (H. Rieder, Esq.), Sundays, 8 P. M.

During a couple of weeks in December, 1923, a 6 kw. Western Electric transmitter was installed at Johannesburg. This station was heard by considerable numbers of amateurs all over the Union of South Africa.

Diners being entertained in a Philadelphia tea-room by radio

Washington and Rome in Communication by Radio

SINCE February 20th, the Navy Communication Service at Washington has been in daily touch with the San Paolo radio station at Rome. This circuit, closed as unreliable some time ago, was recently reopened with IDO, San Paolo, a new radio transmitting station in Italy, which operates on a wave length of 10,750 meters. The messages come to Washington on a loop receiver in the Navy Building over a distance of about 4,500 miles, but go out from station NSS at Annapolis on 17,145 meters. Communication is not effected except between 11 and 12 midnight each night, and so far only eight or ten messages have been exchanged a night.

Canadian Broadcast Fading

RADIO enthusiasts in the zone between Montreal and Toronto, have for a long time been puzzled by the difficulties attending the reception of broadcasting from these cities.

To settle the question definitely and conclusively the E. B. Myers Company sent out an expert from Montreal to make tests and obtain data at numerous points between Montreal and Toronto. The results of these tests are illuminating and highly interesting.

Looking east it would appear that Station CFCA reaches to Belleville fairly well, but at that point the gap appears to commence. For instance—Peterborough, at a northern angle, is almost isolated from the Toronto station, though Montreal stations reached in on occasions.

Kingston hears but little of either Montreal or Toronto, but the chief factor there is that, Kingston being located at the head of Lake Ontario and water routes being most conductive, the powerful American stations sail in with great strength, and practically drown out the weaker Canadian stations.

East of Kingston is the apparent "resistance belt." Brockville, Prescott and Cornwall are seemingly indifferent to Canadian broadcasting, though the latter city breaks in on Montreal occasionally. To catch Toronto is an interesting bit of news among the fans.

As far as Montreal is concerned, Toronto is not isolated because of any atmospheric conditions, despite the failure of a very large percentage of amateur operators to receive the Queen City's broadcasting. The trouble seems to be caused by simultaneous broadcasting by Montreal and Toronto stations and if the program times were altered so as not to conflict, Toronto could be heard readily enough. The majority of complaints come from the central districts of Montreal. Residents in the suburbs and in the upper lever seem to be able to receive Toronto fairly frequently.

Japan's Broadcasting Development

APPLICATIONS for erection of broadcasting stations in Japan have already been filed by nearly a dozen corporations and individuals. They are all well-financed powerful enterprises. In Tokio, beside the Radio Corporation of Japan which is stated to have its connections with the Radio Corporation of America, the Annaka Telephone Apparatus Manufactory, the Japan Electric Power Company, the International Wireless Company, the Matsutaka Kinema Company, the Tokio Municipal Electricity Bureau Laboratory and others are mentioned as applicants. They are all planning to broadcast musical, theatrical and other entertainment.

The Tokio Stock Exchange and some newspapers in Tokio and the Yokohama Exchange at Yokohama have also applied for permits. They will specialize in giving price quotations and general news.

The applicant at Nagoya is a new corporation supported by leading business people of the city. It will make the central provinces of Japan its area of activity. Not only will it broadcast entertainment, but news matter, and price quotations as well.

At Osaka the "Osaka Asahi," one of the biggest and most enterprising newspapers in Japan, has applied for a permit to broadcast entertainment and news.

The newspaper has a small broadcasting station already, but use is not yet permitted although on the ground of conducting experiments it is operated.

The Government wants the corporations to be merged into one corporation, apparently because it will simplify Government supervision. Prior to the grant of permits the Government will induce the corporations to hold conferences and see if they can bring about a merger.

The owners of receiving sets must have their receiving apparatus adjusted by Government officials to the wave lengths of their broadcasting stations. They can listen in only to broadcasting from the station to which their receiver is tuned.

Many radio fans are disappointed because of this law and radio dealers too, find it a handicap in business development.

I. R. E. Radio Officers for 1924

THE recent election held by the Institute of Radio Engineers resulted in the following being elected to serve throughout the year 1924: J. H. Morecroft, president; J. H. Dellinger, vice-president, and W. F. Hubley, treasurer. New members elected to the Board of Managers are: H. W. Nichols and A. H. Grebe. Other members of the Board are: Melville Eastham, Edward Bennett, L. A. Hazeltine, Donald McNicol and Lloyd Espenschied.

Dr. A. N. Goldsmith was reappointed secretary for the present year.

The First Survey of the Ether

Physical Barriers Obstruct Many Electromagnetic Waves

By Edgar H. Felix

The field of radio waves as affected by conditions in New York City

ARE ether waves all-pervading? Is our generally accepted theory of the composition of matter correct? Is it true that we have only electrons circulating freely in a nothingness of ether, collecting in groups of various kinds to form atoms and molecules? Do all such collections of electrons respond in the same way to electromagnetic waves set up by our radio transmitters?

There is much supporting evidence to indicate the general correctness of this theory. We have taken sensitive receiving sets far below the surface of the earth and successfully picked up broadcasting in the Giant Cave of Kentucky and in a tunnel far under the Hudson River. Receiving sets have functioned successfully on aircraft, moving trains and submarines. Is it not correct to conclude that ether waves travel through any kind of matter and are not interrupted by physical objects?

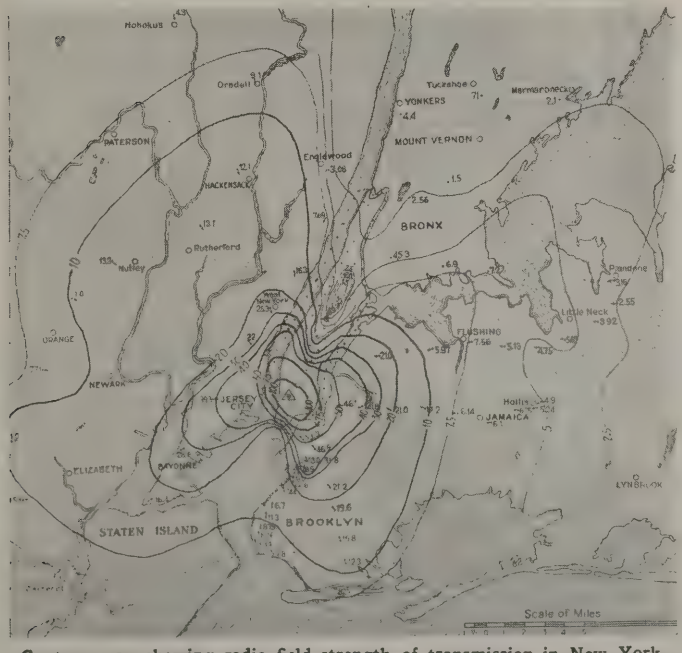
On the other hand, many peculiar transmitting conditions have been noted which supporters of the theory have difficulty in explaining. One famous eastern broadcasting station is heard throughout the West and in Europe, but is difficult to pick up in New England. Another carried extremely well hundreds of miles to the South and West, yet is quite difficult to pick up a few miles to the northward. Evidently there are physical barriers which obstruct the travel of electromagnetic waves which cannot be attributed to the directional effect of the transmitting antenna.

Subterranean metallic deposits are sometimes cited as the cause of transmission difficulties. The experience of amateur short wave transmitters does not serve to confirm this theory. Amateur stations in New York have greater difficulty in establishing communication with stations in Boston and Portland than they have in communicating with stations in Ohio and Illinois. The Central Western stations are twice as far away, with mountain ranges and mineral deposits lying in their path. Neither mountain ranges nor metallic deposits obstruct the travel of ether waves from New York to New England; on the contrary, they have the advantage of a fair proportion of over water transmission when communicating with New York.

Judging from all this conflicting evidence, no satisfactory answer to the question of how electromagnetic waves travel and what conditions affect them will be had until a complete survey of the ether is made. The chief difficulty which has stood in the way of a thorough survey of the ether has been lack of simple and practical measuring equipment by means of which the intensity of received signals may be accurately measured. Fundamentally, such an equipment is simply a means of measuring the received current in an antenna of known constants. But accurately measuring weak signals and maintaining accurately constant conditions in a receiving system is most difficult.

Messrs. Ralph Bown, Carl Englund and H. T. Friis presented a paper before the Institute of Radio Engineers which described a field strength measuring system which has been used successfully in making a survey of the ether of the city of New York. The device consists of a sensitive receiving set, a carefully shielded local oscillator, both coupled by means of an adjustable resistance with a loop antenna. Readings and comparisons of the received signal and signals produced by the local oscillator of such a value that they exactly equal in intensity the received signals served as the basis of measurement. The entire apparatus was mounted in an automobile and measurements were made at many points. In a later paper by Ralph Bown and G. D. Gillett, the results of the first extended series of measurements was made public. The results obtained are indicated on the accompanying airplane map. Station WEAF is shown in the center and curved lines are used to indicate definite levels of reception in the same manner that isometric lines indicate temperatures on a weather map. The first circle shown is a level of 100 millivolts per meter

(*Continued on page* 60)



Contour map showing radio field strength of transmission in New York City with station WEAF working

A Reflex With a Valve Instead of Crystal

A Portable Set

By Laurence M. Cockaday

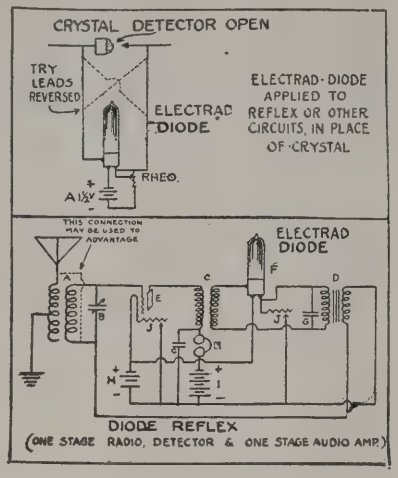
THERE is one serious drawback to the use of a crystal as a detector in single tube reflex sets. This is in the matter of adjustment. The operator has to be forever fooling with the "catwhisker" and eventually he becomes tired of it and gives up in disgust. This is not so when more than one stage of radio frequency amplification is used, because the radio frequency signal then becomes so strong that the crystal adjustment makes relatively little difference.

Another drawback with the crystal detector in a simple single-tube-crystal reflex receiver is the fact that such a simple set seldom makes use of a potentiometer for controlling regeneration. It is all done with the crystal adjustment.

Our readers will recognize that this is true—if they are using such a set—because they will remember that they have to readjust their crystal for any considerable change in wave length.

A Fleming valve or diode tube as it is called by one manufacturer, is one of the original vacuum tubes, having two elements, a filament and a plate. The tube when used as a detector alone, without any radio-frequency amplification, is a steady reliable detector, but it is not very sensitive. It is not quite as good as a fine piece of crystal. However, when the radio-frequency signal has been amplified as in a reflex set, surprising results have been obtained. This is because the radio-frequency voltages applied to the plate and filament path of the tube have been sufficiently increased to produce the proper response through the tube.

The tube used in this way has two distinct advantages, in the reflex set, it produces just as good a signal as the crystal, but it needs no adjustment for sensitivity, and it needs no further adjustment for wave length changes, just set the filament rheostat to the most sensitive point and the set is ready at all times.


CRYSTAL DETECTOR OPEN
TRY LEADS REVERSED
ELECTRAD DIODE
ELECTRAD-DIODE APPLIED TO REFLEX OR OTHER CIRCUITS, IN PLACE OF CRYSTAL
RHEO.
A 1½V
THIS CONNECTION MAY BE USED TO ADVANTAGE
ELECTRAD DIODE
DIODE REFLEX
(ONE STAGE RADIO, DETECTOR & ONE STAGE AUDIO AMP.)

A small portable set has been giving satisfactory signals from a loud speaker on local signals and has been picking up DX quite consistently on the phones.

PARTS FOR SIMPLE REFLEX RECEIVER

One Fada variocoupler and 3-inch dial.
One nine point multiple inductance switch.
One Amsco variable condenser .0005.
One 3-inch dial.
One Cardwell radio-frequency transformer.
One Cardwell audio-frequency transformer (For First Stage).
One W.D. vacuum tube.
One Electrad diode tube.
Two Micadon fixed condensers .001 mfd.
One 1½-volt dry cell.
One small B battery, 45 volts.
Two rheostats, 6 ohms, and 2 knobs or dials for same.
One regular vacuum tube socket.
One diode tube socket.
One pair N & K phones.
One panel 7 x 12 inches.
Cabinet 7 x 12 inches.
Four ft. connecting wire and 4 ft. of bus wire.
Six binding posts Eby Junior or others.
Wire solder.

Your dealer can supply alternative parts at his discretion.

In building the set, the best procedure would be to mount the variocoupler on the left end of the panel—looking from the front—with the variable condenser beside it.

The two rheostats should be mounted next beside the condenser with the WD-12 and the diode tube directly in back of them respectively.

Then mount the two transformers on the base in such a manner that the connections will be as short as possible.

In wiring the set, follow the diadram exactly, connecting the two fixed condensers, one across the primary of the audio-frequency transformer and the other across the phones and the "B" battery. Keep all the wires as short as you are able to and keep the grid connections isolated from the other parts of the wiring as much as possible.

If you already have a one, two, or three tube reflex set with a crystal detector you may use one of these tubes obtaining an extra rheostat, a dry-cell of 1½ volts and connect it directly to your present crystal detector stand as indicated in the figure. This will enable you to compare the two methods of detection for yourself.

You will be pleasantly surprised by the quality of the signals received on this little set and will find that you have been amply repaid by trying out the circuit.

RAILS: A Radio Language Society

A NEW radio organization is here. It is led by well known radio men who are developing the use of the Auxiliary International language Ilo for amateur and broadcast work.

The organizer is O. C. Roos, a Fellow of the I. R. E., who has taught the language for many years. He corresponded in 1911 from the wilds of the Orient with engineers in Europe, Kashmir and Japan, and taught Filipinos and Chinese to use the language in exchanging the products of their country with teachers in England. "Ilo" (now called "Ido" by many), now being taught in Boston's two radio schools, gratis, is meeting an actual demand among radio fans.

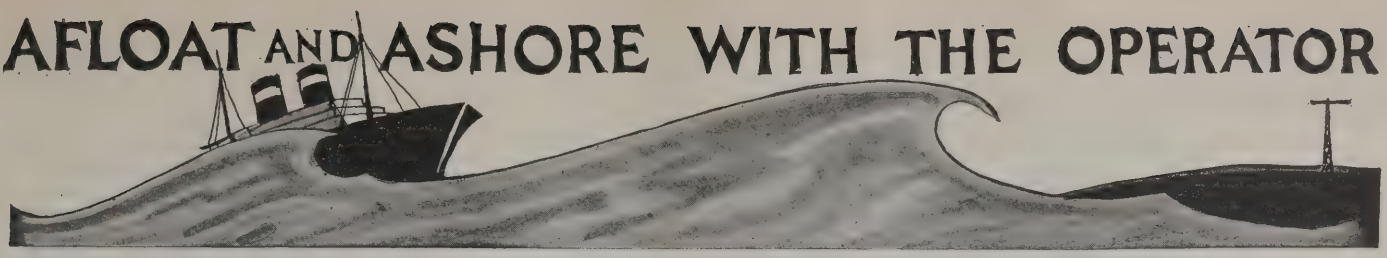
The new organization is called "RAILS"—or Radio Auxiliary International Language Society. Its exchanges of information with foreign fans will be by radio telegraph or post. It will eventually publish an official monthly—probably next Fall — and will give lectures on radio subjects as a means of teaching "Ilo."

The officers of the RAILS so far chosen are E. F. W. Alexanderson, and John Stone Stone, honorary presidents; John Hays Hammond, Jr., honorary vice-president; O. C. Roos, president; C. E. Kolster, vice-president; George Lewis, executive secretary; Guy Entwistle, treasurer. There are also foreign correspondents, linguistic advisers and other officers to be chosen.

The organization will be a link between the amateur, or broadcast listener, and the radio leaders in foreign fields. Much interest is shown by the fact that Mr. Roos is getting about 35 letters a day at Beacon Chambers, Boston, Mass., at the the Boston *Sunday Advertiser* in regard to the work he is doing. He will answer all questions addressed to either of the above places.

Radio communication is making every fan "world-conscious," and this feeling is dissolving before our eyes the age-old prejudices against a synthetic language which so many literary folk have hitherto invoked to impede the movement. Radio amateurs may do in two years what academicians and literary lights have failed to do in several decades. The slogan of the new society is "RAILS Across the World."

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

SAN FRANCISCO boasts an old-timers' club called "Radio Pioneers," comprising men who were in the radio profession prior to ten years ago.

The Atlantic Coast is not quite as fortunate in having such an exclusive organization, but if there were one it would produce some mighty keen rivalry. As a matter of fact the Atlantic Coast could have a fairly large organization of pioneers who are *right now* sea-going operators and who entered the field as such over *fifteen* years ago.

Many of these men are well known while others have kept in the background; nevertheless all have records to be proud of.

R. W. Toms E. N. Pickerill O. L. Goertz B. Beckerman

E. N. Pickerill, chief operator of the *Leviathan,* the pride of America's merchant marine, was a professional radio operator nineteen years ago. He has seen varied service both at sea and in shore duty and now has seven assistant operators under him on the big ship. During the war he was a lieutenant aviator in the United States Army. Pickerill is a real American—a member of the Sons of the American Revolution.

Benjamin Beckerman was assigned to a ship of the Old Dominion Line in 1908. He is still running on that line as senior operator of the *Jefferson,* and this long service was broken only by his naval enlistment during the war and by not more than a trip or two on other steamship lines.

Frank E. Black, chief operator on the big trans-Atlantic liner *America,* started before the head telephones came into use as receiving equipment. In his day the incoming messages were recorded on tape which, incidently, also recorded all the static and lightning flashes. Old telegraph operators in Black's class began to read the click of the relay, which enabled them to pick much more of the message out of the static and have it on paper some little time before those who had to translate from the tape. This eventually brought about receiving by sound rather than sight, and had it not done so there would be no present day broadcasting. At the time Black started no signals had been heard at as great a distance as a hundred miles! Is Frank Black an old timer? Rather!

Arthur Cohen, an assistant on the *America,* started his radio career in February, 1905, and has been actively engaged in it practically ever since, even during the war when he was a naval radio instructor at Cambridge.

Milton O. Green dates his radio service back about fifteen years. He was manager of the New Orleans coast station thirteen years ago, has since been chief on large trans-Atlantic passenger liners and is now on the Isthmian Line freighter *Steel Seafarer.*

Herbert M. Rodebaugh is said to be the oldest man both in years and in point of service along the Atlantic Coast. He had the distinction in 1917 of being in charge of the first ship to carry a girl junior operator, which, incidently, is the same ship on which he is now running—the *Howard* of the Merchants and Miners Line.

Robert W. Toms, now on the *Steel Trader,* has been continuously engaged as a ship operator more than sixteen years, this record being broken only by his war service in France, during which time he engaged in the famous battle of the Mons. He holds a medal issued by the British government as one of the number who actually saw the "Angel of Mons," which appeared one night during that bloody battle.

Oscar L. Goertz became a wireless operator on ships during 1906. From 1914 to 1919, he was in the United States Army Signal Corps on foreign service in the Philippine Islands. He holds a Signal Corps experts' certificate showing proficiency in radio and telegraph circuits, as well as operating and maintenance. Following his discharge he again took up ship operating and for the past two years was chief on the *President Van Buren* running between New York and London. He is now temporarily assigned as senior on the *Jamestown.*

James F. Forsyth—they all call him "Doc"—now running between New York and Mediterranean ports on the *Carenco,* is said to have not had a trip off as a vacation in the past thirteen years and five months. Doc is one of radio's old stand-bys and one of the best.

Henry F. Bollendonk, one of the *Leviathan's* crew, is primarily a telegraph operator with experience on railroad, Western Union, stock, press and cable circuits. He became a wireless man on ships in 1910.

Robert Lee Etheridge, is, as his name suggests, of old Virginia stock. He entered radio in February, 1910,

(*Continued on page 74*)

J. F. Forsyth C. E. Stevens H. Hatton E. J. Marschall R. W. Young F. W. Harper M. B. G. Rabbitts E. W. Rogers

Killing Receiver Noises

By R. A. Bradley

TO the broadcast fan who has not the working knowledge and experience of the hardened amateur, a radio set not working properly or entirely out of order in most cases presents a problem quite out of his ken. The conglomeration of knobs, condensers, rheostats, sockets and transformers seems quite akin to the proverbial Chinese puzzle. While he knows, perhaps, the general workings of the "insides," he is at a loss to know where to start, if for instance during the course of an evening's program the set goes dead. Now if this same fan had before him an outline of the things which *can* go wrong and *why* they go wrong and how to set them right, he will then have a good idea of where to start and consequently be able to trace his difficulty immediately, without aimlessly connecting and disconnecting wires and making futile adjustments. To this end we have prepared this outline, "Trouble Analysis." This is the initial instalment and succeeding issues will give the second and third of this series.

1. There are various sounds which come out of the phones or loud speaker of a radio set, which to the uninitiated mean nothing, but to the expert or old-timer each means a definite thing—either natural and uncontrollable or the exact indication of trouble—where it is and what to do to remedy it. We have done our best to describe in cut and dried words these sounds, classifying them under noises and squeals. In this instalment we tackle the noises since they generally mean actual trouble, whereas squeals more often denote improper adjustment or lack of experience in tuning on the part of the operator.

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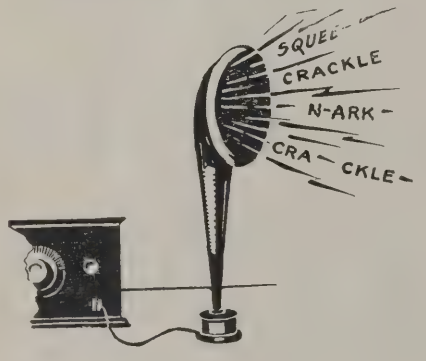
1. Crackling and frying noises varying in intensity and appearing spasmodically.

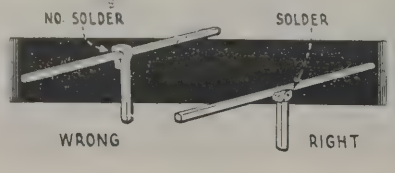
1. This may be due to atmospheric disturbances, and this form of noise is probably something entirely beyond our control and which no radio set can eliminate. Most prevalent in summer time though very bad preceding, during and following a rain storm and during a fairly heavy snow. Static should not greatly disturb reception from local stations.

2. Crackling of fixed intensity, irregular in occurrence—accompanied by the momentary loss of signal—out and in.



2. Antenna—The swinging of an antenna so that it makes contact with any non-insulating or conducting object will set up in the receiver a great crackling noise, sometimes totally obliterating any signal. An antenna should be as taut as the wire will stand and the masts properly guyed or supported to prevent swinging in any wind short of a gale. Very often too little attention is paid to insulators. Observation has shown us that a man will spend two hundred dollars on an elaborate receiving set and then go to the "5 and 10" for his insulators. Your antenna together with the ground connection constitutes your entire and only means of intercepting the tiny bits of energy which are converted in your receiver into music and speech, so make it good and permanent.

3. Crackling present only when set is jarred or moved.



3. Broken or unsoldered connections. Very often in bought sets as well as home made, bad connections develop. Sometimes noises may be traced to a badly soldered joint or one that is not soldered at all. The best way to find such a joint is to move all the wires with the finger tips while the set is running. Upon striking the right one there should be a pronounced crackling in the phones. For the purpose of such a test the wires should be merely touched and very lightly as a more complete contact with the fingers will produce other sounds which are apt to be confusing.

THE RADIO DOCTOR.

In nine out of ten instances the average person can remedy his own difficulty if a definite procedure is followed. There are a few things to do first, just as they tell you to do, before the doctor comes. If you were to call in an expert in your particular case, he would in all probability ask you about the "symptoms" before even touching the set. He would ask you the state of charge of your storage battery, the condition of your B-batteries and probably ask you what results you had obtained from the set previous to its "illness." Then he would turn to the set, turn on the rheostats controlling the filaments of the tubes and if the tubes lighted properly, it would mean to him that the filament circuit was all right. Then he would insert the phone plug in the jack and if he heard a slight click as the plug made contact with the prongs of the jack, he would know that the B-battery circuits were correct and complete. With this start he would undoubtedly endeavor to make the set give forth some sounds by which he could trace the difficulty just as we have outlined their various meanings in this article. If the set refused to respond at all, and was to all intents and purposes a "dead set" he would then follow a different course which we will outline in a following issue.

NOISES
SQUEALS
SILENCE

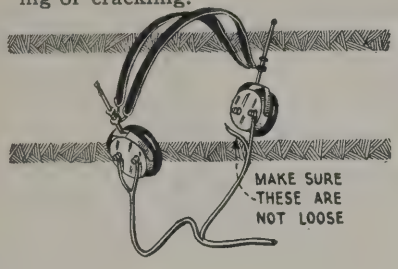
Which of these three are "getting your goat?"

This series of
Radio Diagnosis Articles
will help you to get better results from your receiver

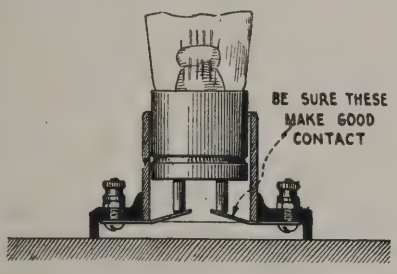
June: *Squeals*
July: *No Signal*

Watch for these numbers

4. Complete fade-out and in of signal while set is untouched and undisturbed in any way, accompanied perhaps by slight clicking or crackling.



5. Marked fading and reappearance of signal upon jarring set.



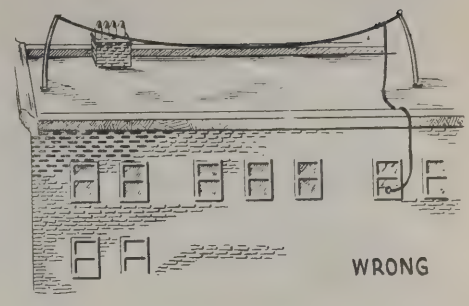
6. Continuous and loud frying and crackling noises despite adjustment of dials or rheostats.

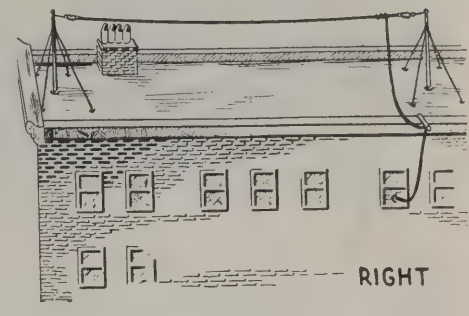
7. Marked hissing despite adjustment of dial, controlling means of regeneration.

4. Phone cords and loud speaker cords often give trouble in the way of producing noises in the set. To test for this trouble, the phone cords should be stretched and jerked while the set is in operation. If in jerking in this way all sounds go out with a click the trouble, you can be sure, is a broken wire in the cords and these should be replaced. However, if the trouble does not lie here, the connections in the receiver cases should be examined and if necessary the phone cap and diaphragm removed to ascertain whether there is a poor or broken connection here.

5. Sockets—There are on the market today only a few really good sockets. So this is a place where trouble often develops. If you have a manufactured set do not attempt to substitute other sockets for the ones therein, but if yours is home made, spend a dollar for a good socket with good contacts and throw out your 15 cent "mounted mud" ones. Remember that a tube is no better than its socket. Dust often collects on the contact springs. These as well as the tube prongs should be kept clean by touching them up with a fine file once in a while. Be sure the prongs have plenty of "pep" in them and are bent up far enough to exert pressure on the prongs of the tubes.

6. B-Batteries.—Any fault in the B-battery leads may be traced at once by inserting the phone plug into the jack and removing it. There should be a slight click if all is well. If there is none, trace the plus B lead from battery to phone jack. One of the most well known and reliable manufacturers of B-batteries advises the discarding of 22½-volt units when the voltage has dropped below 17 volts and the 45-volt batteries after they have dropped below 35 as then the battery becomes noisy and produces much of the hissing and frying noises that we





hear in some sets. This noise is present only in the dry B-batteries, the storage B-battery not having this characteristic. If you have a neutrodyne or superheterodyne or any set having five or more tubes it will pay you to install storage batteries instead of the dry cell type. The recharging is simple and inexpensive and the original cost very little higher than the dry battery and it will prove in the end cheaper.

7. Do not force your tubes. You may find that by "racing" the rheostat you gain a little in volume. This only shortens the lives of the tubes and should be avoided on soft detector tubes. A pronounced hissing will be noticed when the rheostat is advanced too far.

Next month we will describe "Squeals," whence, wherefore, why and why not. Watch for it. Cut out this article and save it to use with the following ones as the series complete will form a convenient means of "knowing" your set.

Wireless Age Set Pleases

Mr. Abraham Ringel's article on "Distortion-Free Amplifiers" in the December number still elicits favorable attention from readers. Here is a sample.

THE WIRELESS AGE:

Gentlemen—I am so enthusiastic over the operation of a set built from a hook-up published in a copy of WIRELESS AGE I am writing you immediately upon the completion and trial of the set.

The set is the one described by Abraham Ringel in the December, 1923, issue. It is the four-tube resistance coupled amplifier.

It does everything the writer claims and far more. In addition to the most perfect and clear reception I'll ever ask to hear, you can plug in several sets of headphones on the second and third tubes without affecting the operation of the loud speaker in the least.

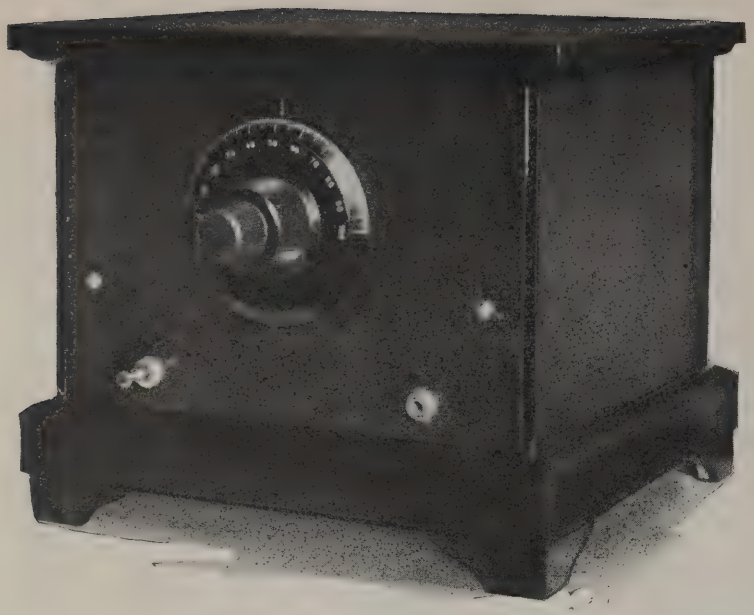
While Schenectady, which is only 30 or 40 miles away, was broadcasting its second anniversary program last night, and the set in question hooked up for the first time with no alterations whatever, I was able to pick up Atlanta, Georgia, and Memphis, Tenn., not to mention nearer stations on a loud speaker.

It operates a Western Electric 10A speaker perfectly without the use of the power amplifier with as great volume as any one would ever ask to hear and also without any distortion.

Instead of 201-A tubes, I used 4 UV-199s and only 80 volts of B battery. I used four grid leaks (a variable one on the detector), four grid condensers (Dubilier) and 3 Lavite resistances, one 48,000 and two 80,000 ohms.

WIRELESS AGE is the only publication I have ever been able to build a set according to their instructions and have it work satisfactorily without subsequent alterations. Kindly extend my compliments to Mr. Ringel as well as to WIRELESS AGE.

Most sincerely,
GEORGE HAYNES,
Hoosick Falls, N. Y.



The Twin Control Receiver

An Easily Built Regenerative Set

By H. Mace

THE desire for radio sets which operate with dry-cell batteries, fewer dials, and which are capable of operating a loud speaker efficiently, is taking our radio fans by storm. In this article let me introduce to you a radio set that takes up only one square foot of space on your desk or library table. This set is twin controlled.

It might interest you to know just why we call this a Twin Control; it means, that you tune by means of one dial which has a hole bored through it and through which a shaft is placed to operate a coupler which is mounted on the back of the condenser. This system of control can be used not only for the circuit given, but for any circuits embodying a condenser and coupler.

We will not claim that after you have built your set you will be able to hear night after night a station 750 miles away, but we will say that if it is constructed in accordance with the instructions here given you will get satisfactory results providing that you have at least two good things to aid you besides the set: a good aerial, and a good ground.

As you are not a laboratory worker we do not show a laboratory experiment; we merely show you, as the architect shows you a finished plan of a house, a good radio set that will be a pleasure to look at, and fit for any room in your home. We have made this layout simple and neat.

It is always of advantage to test parts of your set before assembly. You can test several different ways, but the best for your home test is a small voltage battery and a pair of phones. First test the phones and cord and the battery; put one end of

EQUIPMENT

One 23-plate or of .0005 mfd. capacity condenser which is vernier variable. It must have a spring tension on the back to hold the main rotating plates from moving of their own free will, when the vernier attachment is taken off.

One standard make medium size variocoupler.

(The Fischer Single-Trol may be used in place of separate coupler and condenser.)

Three standard tube sockets. These may be of the gang variety.

One 6-ohm rheostat.

One switch lever, with 3 points and 2 stops.

One base panel 8″x9″.

One front panel 7″x10″, grained.

One phone condenser .001.

One grid condenser .0005 and grid leak ½ to 5 megohms.

Nine lengths of bus bar.

Two brass brackets to mount panels.

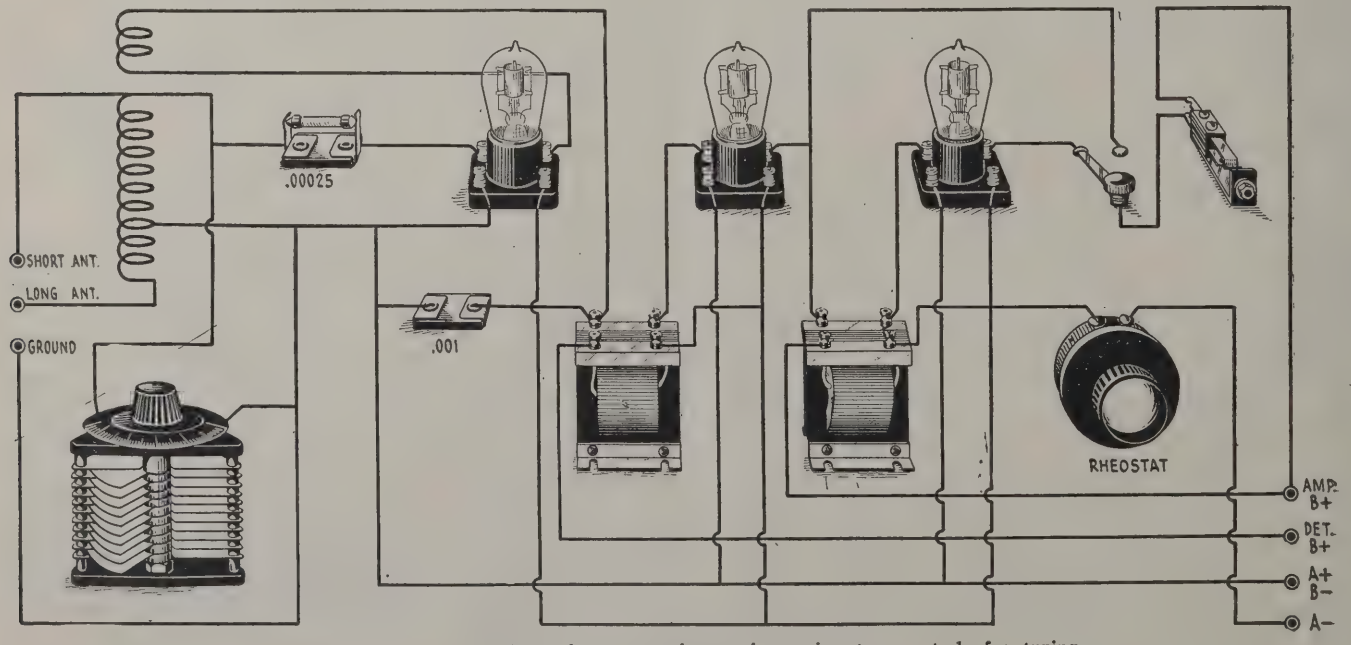
One single circuit jack.

One special shaft of the size to fit the small hole through the condenser and also the coupler rotor.

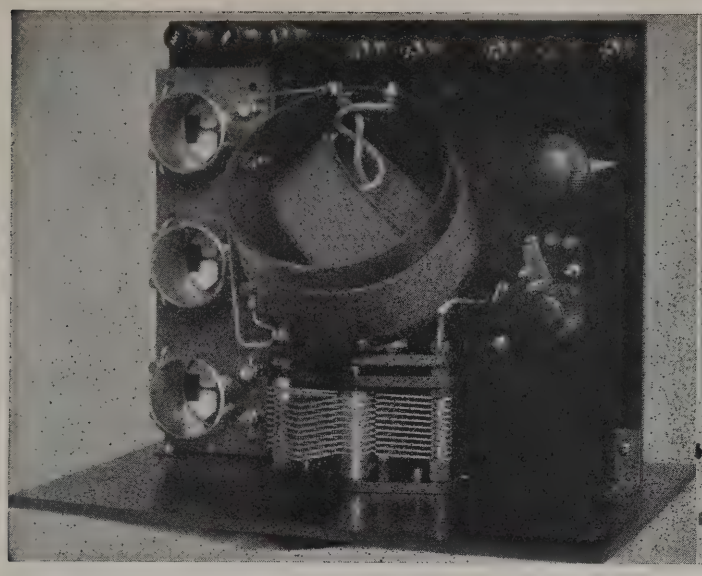
One Cutler hammer—snap switch.

Two audio frequency transformers.

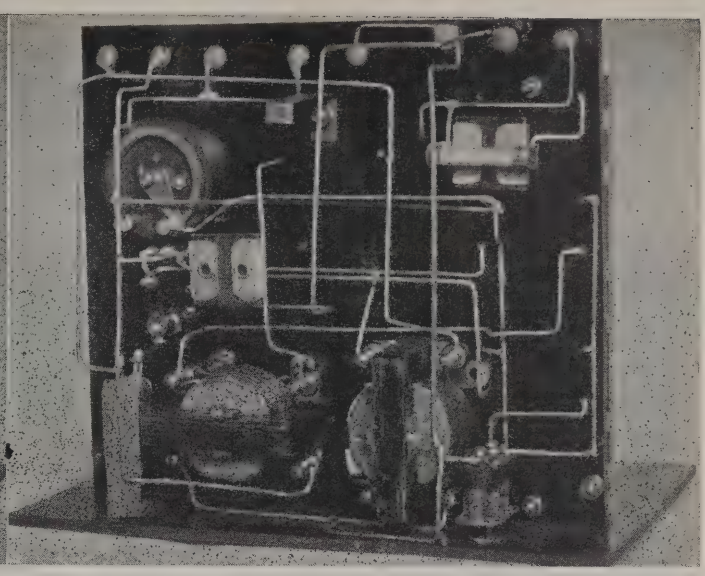
One four-inch dial, and a small knob to fit the smaller shaft.



Circuit diagram of the three-tube regenerative receiver using two controls for tuning



View above the sub-panel showing tube sockets, vario-coupler and variable condenser



The transformers, rheostat, fixed condensers, etc., are placed underneath the sub-panel

the phone cord to the negative post of the low voltage battery; this will give you two open ends which when placed together should give you a click. If this does not happen either the phones are defective or the battery is dead. If it is O. K. you can then test couplers and transformers by placing the ends of the phone cord across the open ends of a single coil of either the coupler or transformer which should give you a click. If there is no click you should look for an open or broken wire in the circuit. If the coupler is defective you can repair it, but if it be the transformer you must take it back to the dealer and have him replace it. Test your variable and also your fixed condensers for shorted plates; of course when a condenser shorts you will get a loud click. If the fixed condenser is defective you must get a new one. If the variable condenser shorts, bend the movable plates.

ASSEMBLY

In assembling this set it is advisable to start assembling the parts on the base panel. Measure up the holes for the different parts, then mark them and drill your panel. Then fasten the angle brackets to the front ends on the edge of the panel, and mount the jack, tuner and switch to this panel. Your radio set is now ready to wire. It is best to put all your sockets on the left hand side and the transformers on the center bottom of the base panel, then the rheostat and switch lever to the right hand side.

WIRING

In wiring the set let me suggest that you start one side of the battery and finish up on all connections on the A battery, then take in the B battery connections. Then take plate connection, by-pass condensers, and then the grid wires and aerial ground binding post connections. After you have finished the wiring check each wire on the set with the connection in the drawing.

When soldering see that all your soldered connections are tight and will not come off when roughly handled. It is advisable, but not necessary, to solder the transformer connections. I used mounted transformers, you may use any type, mounted or unmounted.

It is advisable when the set is finished to first connect the A battery and see if the filament circuit is complete so that your tubes will light. This does not mean that the set is perfect as you may have a mistake in a B battery connection. So after testing the tubes with just an A battery take the tubes out and make all B battery connections along with the A battery connection. Then test with a voltmeter across the filament terminals of the sockets and see that the voltage reads the same as that which is generated by the A battery. If it is above that generated, you must look over your set for a wrong connection in the filament circuit. After you have done the above you must then connect up the aerial and ground, and the phones.

ACCESSORIES

One special cabinet to fit the set.

One A battery of voltage great enough to light the tubes used.

Four 22½ volt B batteries.

Three 201 A or 3 WD-12 tubes.

One pair phones.

One loud speaker.

Two phone plugs.

Several feet of flexible single-wire lamp cord for battery and aerial and ground connections.

I would like to caution you to guard against getting the tickler coil reversed, or the transformer connections reversed. Look out for wrong battery connections. In soldering be careful not to get solder upon the fixed condenser so as to short it. Make sure your connections are all tight.

I have not placed a rubber panel vernier on this outfit, but one might be used to advantage.

Civil Service Examination

THE United States Civil Service Commission announces an open competitive examination for Junior Radio Engineer.

The examination will be held throughout the country on May 7. It is to fill vacancies in various branches of the Government service, at an entrance salary of $1,860 a year.

Applicants must have been graduated with a degree in engineering, preferably in radio engineering, from a college of recognized standing; or must be senior students in such course and furnish within three months from the date of the examination, proof of actual graduation. Applicants who have completed two full years of the engineering course may substitute for each of the additional years, one year of experience in radio engineering.

Competitors will be rated on general physics and chemistry, pure and applied mathematics, practical questions on radio engineering, and education, training and experience. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. Civil Service examiners at the post office or custom house in any city.

When Your Motor Generator Fails at Sea

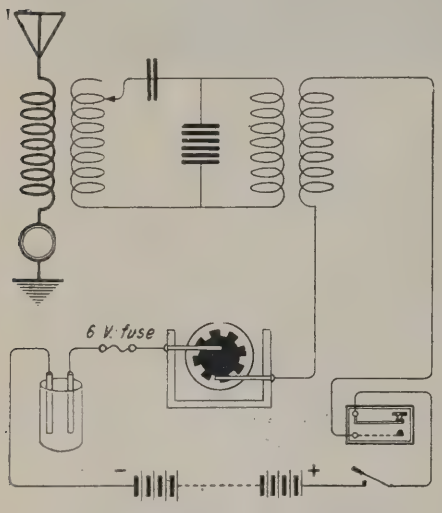
An Emergency Transmission

By Otto E. Curtis

Operator, S. S. *Sugillenco*

ON February 26th, 3 P. M., when our motor generator aboard the *Sugillenco* ceased to operate, I found it necessary to try several ideas in order to restore our ability to transmit.

We took out the armature, repainted the places where it had been scraped,



Hook-up of the emergency transmitter

and replaced it. Tests were made of both fields and armature, but still the armature refused to rotate.

I then devised a system to get alternating current for transmission without the use of the motor generator, the system being to interrupt periodically the direct current from the batteries, running it through the primary of the transformer, and thus get alternating current from the secondary. The theory of operation of the transformer would then be like that of an induction coil.

The rotary gap was first used to interrupt the battery current—contacts to the rotor being placed at opposite points on the stator. The rotor revolved at such high speed that these contacts were either broken or permanently thrown away from the disc. This interrupted the battery current permanently, so the rotary gap could not be used.

The next attempt was to send with an electric fan, operating an interrupting wheel. Connection to the base of the fan and contact to the fan blades could not be used, for when the battery current operated both the fan and the transformer primary, a theoretical condenser was formed between the armature windings and the fan shaft on which the blades were mounted. Theoretical data determined that in time the dielectric stress across the insulation of the armature windings would cause this insulation to deteriorate, and thus short circuit the windings, rendering the motor useless.

Hence an insulated bushing was made with a file by turning a spool mounted on the fan shaft and to this was affixed eight tin fan blades. Contacts to these were made with brushes. Due to the irregularity and flexibility of the tin blades the note was rough and unreadable.

The System That Worked

The final system that worked is shown in the accompanying diagram. A wooden wheel, nine inches in diameter, had mounted upon it a brass wheel cut with eight teeth. A hole was bored in the center of the brass disc, so as to insulate it from the shaft. The entire wheel was then mounted on the fan shaft with appropriately keyed bushings, made from wooden spools. The spaces between the brass teeth were filled with pieces of iron, insulated from the brass and electrically dead. These were for the purpose of making the entire surface "flush" and to prevent a jumping of the brushes. The right-hand brush operated to break the contact every time a tooth of the brass disc passed, while the left-hand brush received continuously the current from the disc.

In the diagram, the current will be seen to pass respectively, from the positive pole of the battery through two opposite safety contacts on the antenna switch, through the key, primary of the transformer, "interrupting wheel," 6-ampere fuse, salt water rheostat, and thence to the negative pole of the battery.

To determine the resistance of the circuit four cells of storage battery in series, giving 8.6 volts, were connected to the circuit battery leads, and the amperage of the circuit measured, first with the salt water rheostat short circuited and then with the resistance of the salt water in circuit. This voltage divided in each case by the amperage ($R = \frac{E}{I}$) gave first the resistance of the circuit without the salt water rheostat and then with it. Thus the proper circuit constants were determined.

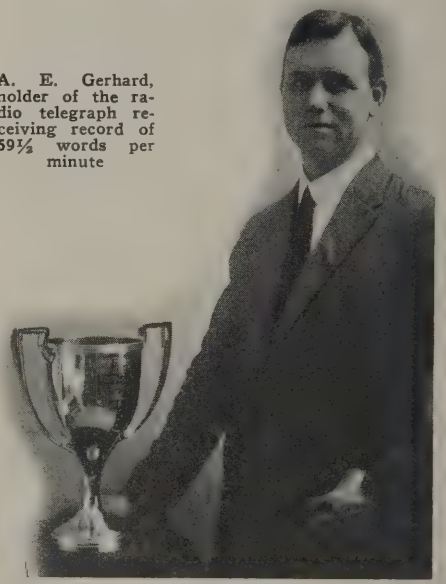
Another easy way to make the wheel, would be to saw the brass disc into sectors. Thirty-two sectors would give an easily readable note.

A small induction coil carried by the operator for emergencies in which the motor generator refuses to function and cannot be fixed at sea will eliminate the necessity of any such amount of work.

All messages I had on hand to send were transmitted by this system to WNY, and communication went on without loss of time.

Radio Telegraph Receiving Record

The world's speed record for copying of radio telegraph code signals was shattered when A. E. Gerhard received straight copy at the speed of 59½ words per minute, at a contest held at the Fourth Annual Convention of the



A. E. Gerhard, holder of the radio telegraph receiving record of 59½ words per minute

Second District Executive Radio Council at the Pennsylvania Hotel, New York, March 7th.

What a remarkable accomplishment this is can best be appreciated, perhaps, when one figures that his record is three times the average speed used in ship radio communication. Gerhard, who is an operator in the employ of the Radio Corporation of America, is here shown holding the trophy awarded by the Second District Executive Radio Council to the winner of the contest.

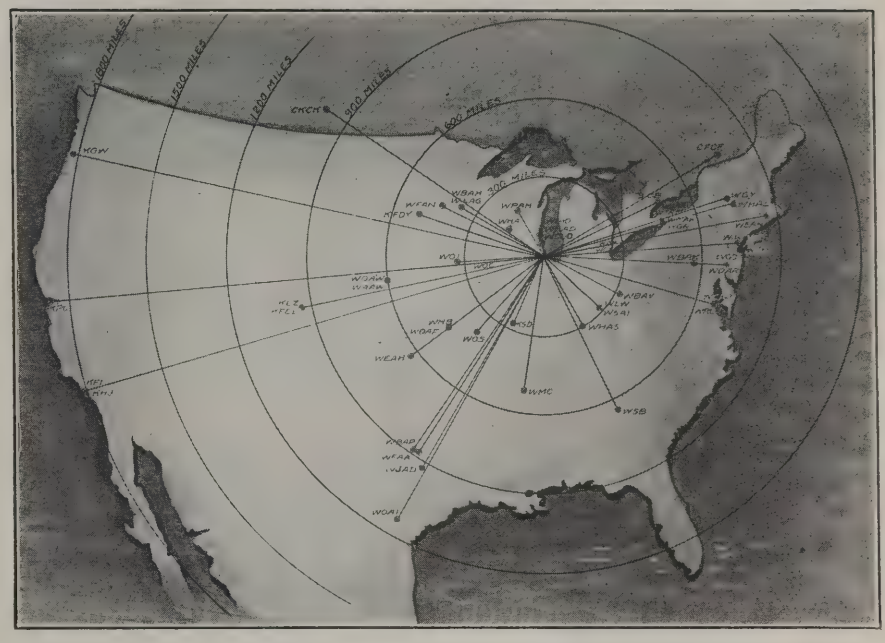
Non-Radiating One-Tube Reflex

Here Is a Simple, Easily Constructed Set With Single-Circuit Tuning

By W. P. Lukens

THERE can be no denying that the reflex type of circuit has been much in the public eye of late, but it is also undeniable that it has not met with the favor it deserves. This is due to several things. In the first place the reflex circuit has generally been heralded as the solution to all antenna difficulties and is supposed to work on a loop or on a very short inside antenna. This is true, but the general public usually takes such statements to mean that a reflex set will work as well on a small antenna as a regenerative set will on a good outside antenna. That is where disappointment ensues. Recently the makers of the Erla products have stated that while their reflex circuits can be used on loops, reception improves proportionally with better aerials approaching the maximum with a good outside aerial; and that is a true and concise presentation of reflex facts.

Another element which prevents reflex popularity is the fact that so much emphasis has been placed on multi-tube circuits and not enough on the single tube. The latter is highly efficient, easy to build, easy to operate, surprisingly stable in its action and very true in its reproductive qualities. I am hoping that more and more of the single tube sets may be used and that experimentation with multi-tube circuits will be left to the laboratories and specialists. There is no reason why eventually it may not be as easy to build and operate a 3-tube reflex as it is a 3-tube regenerative, but right now the single-tube reflex is all I choose to bet on for 100 per cent. results in the hands of the usual B.C.L.



Map showing the range of the one-tube reflex receiver

Let me recount a few of my own experiences, then decide for yourself whether the reflex has merit.

Some eight months ago I had run the gamut of Armstrong, Reinartz, Ultra-audion and similar circuits; had read and heard much about the "Super," Flewelling, and others of that class, and had finally decided—considering the presence of a potentiometer and an R. F. transformer in my junk box—that the reflex afforded considerable fields to conquer. For several weeks I collected circuits ranging from 6-tube R.F. to single tube reflex, studying them until I had some little idea of what went on in them. Then one day in a newspaper I found a simple little single-tube reflex circuit which looked easy to start on. As I recall, it had so many resemblances to my ultra-audion with one stage that I promptly re-wired the latter in accordance with the reflex diagram—using as extra parts an R.F. transformer, crystal, fixed condensers and potentiometer from my junk box. Even the socket of

(*Continued on page 76*)

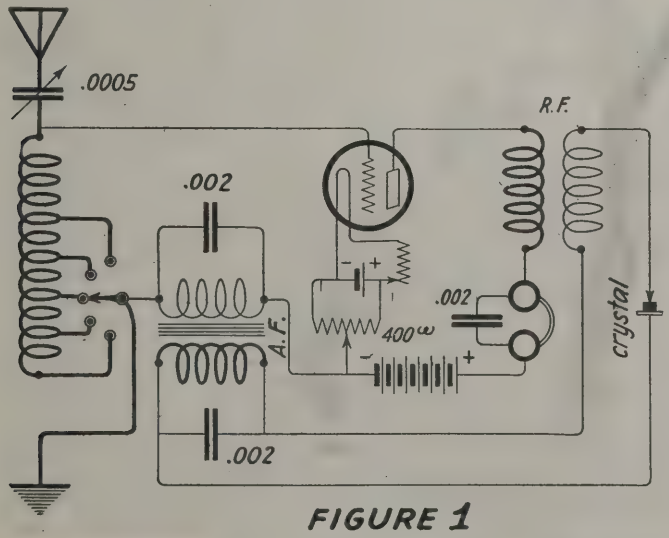


FIGURE 1

Hook-up of the one-tube reflex using a tapped primary instead of a variometer for tuning

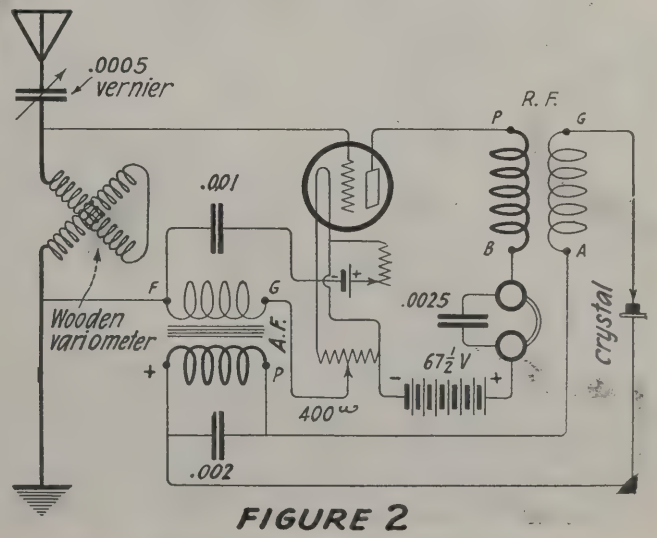


FIGURE 2

The standardized reflex hook-up used by the author

E. F. W. Alexanderson, chief consulting engineer of the Radio Corporation of America

Your Future as a Radio Engineer

With Thousands of Experimenters Planning to Become Radio Engineers, the Field May Appear Overcrowded, But the Process of Elimination Has Left Plenty of Room at the Top

By M. B. Sleeper

Radio Designer and Technical Publisher

WHEN you see, on a radio man's card, Imanex Pert, A. M., I.R.E. Radio Engineer, don't take him too seriously. Associate membership is extended quite broadly to persons who are interested in the work of the society; but full membership is another matter and a real radio engineer, who will probably be a full member of the Institute of Radio Engineers, is an individual whose qualifications are worthy of emulation.

Of all branches of engineering, radio is one of the most interesting, and, within the last few years particularly, those who have made real contributions to the art have been adequately rewarded. Others, who have done important, if not spectacular work, have no cause to complain, for they have been able to command high salaries for work of a most fascinating character.

In every man's life there is usually the recollection of a council of war, held during the third or fourth year of high school, on which his whole future turned. I imagine that, in many of these councils nowadays, radio is the topic under discussion. Perhaps you are thinking that your war council is not far off, and you are preparing for it, reading, asking questions, taking stock of yourself.

Before all others, you must settle one point—do you like mathematics? Don't side-step or temporize. Either you enjoy mathematics and get good marks, or you hate the subject and you get poor marks. If you can eat figures, stand by for the next questions. If equations are just groups of little dancing devils, you are probably headed in the wrong direction.

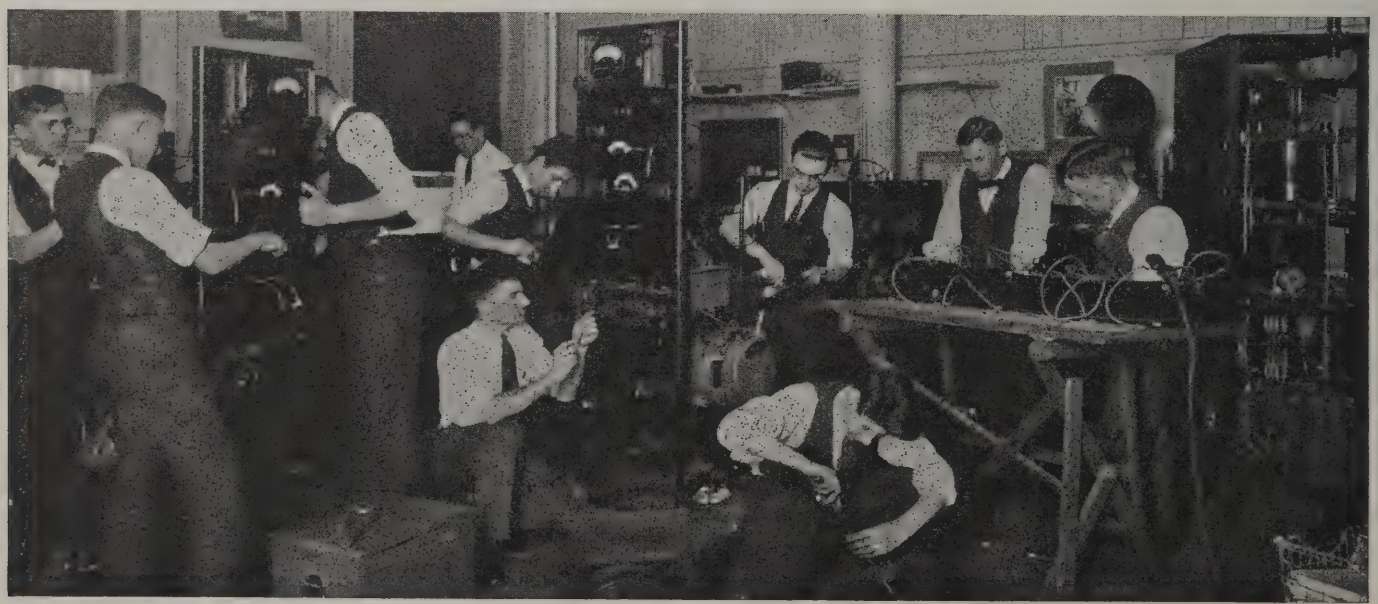
Don't say, "Yes, but I love to play with radio, and I know I can become a radio engineer." No doubt you do love to play with radio, and perhaps you can make a success of radio as a life work, but not as an engineer. Your part may be in manufacturing, broadcasting, publishing, or selling.

A radio engineer, by degree, must first go through the four years of college necessary for the degree of electrical engineer, followed by two years of postgraduate work before he be-

RADIO AS A CAREER

In the December number of THE WIRELESS AGE, Mr. Pierre Boucheron contributed a highly interesting article which presented a survey of the opportunities in radio today. This subject, of vast concern to thousands of American boys and young men and their "dads" and well-wishers, has been developed more in detail in later numbers. In February, Mr. M. B. Sleeper, the author of this article, contributed a story describing how one may become a radio salesman. In March, Mr. W. S. Fitzpatrick, whose activities lead him into daily contact with the careers of a great many ship-operators, told of the opportunities that await the energetic and ambitious young man who decides to become a ship operator. In our April number, Mr. Sleeper, who has had considerable manufacturing experience in his own career, told of the opportunities in radio factories.

This series of helpful Radio Career articles is designed to satisfy an insistent and definite craving on the part of great numbers of people to know just what opportunities this rapidly developing business of radio offers to the earnest and ambitious success-seeker.



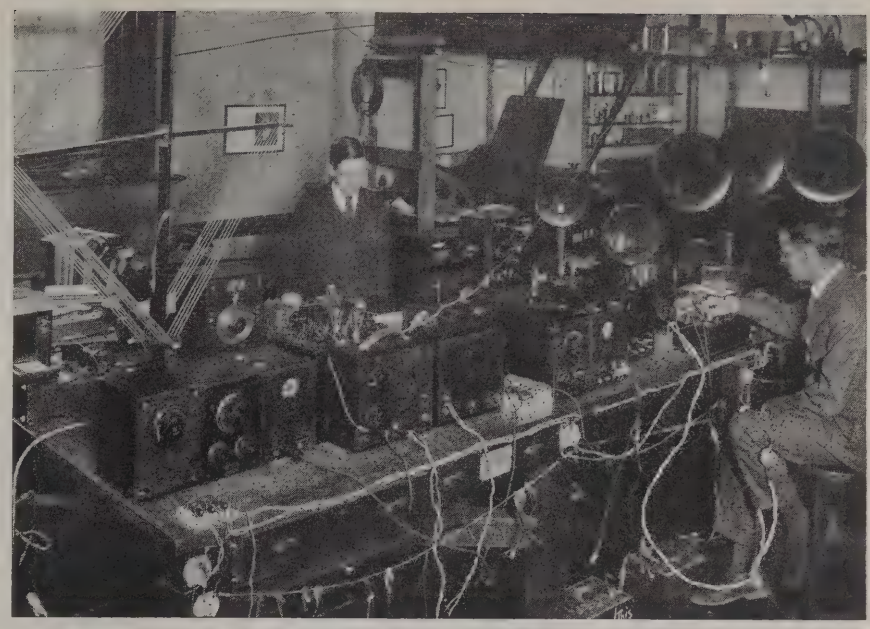
Students in radio engineering receiving instruction in practical work of assembling apparatus and conducting laboratory experiments

comes a radio engineer. There is another problem to be settled. Are you willing to put in those six years of study, and can you afford it? Perhaps you feel that the four years are only preliminary, and that you'd like to start on the last two right away. If so, you are wrong, for an engineer is a man of education, not merely a product of a college laboratory. Studies other than engineering subjects contribute to the general education of an engineer, for he cannot carry on his work most effectively without an understanding of and an interest in the world affected by his endeavors. As for the studies required for the degree of electrical engineer, thy are absolutely essential, for radio is electrical engineering plus special training covered by the extra two years. In many cases, the radio engineer is assisted by electrical engineers.

I have had experimenters say to me, "That's all very well, but the knowledge required for Armstrong to invent regeneration was no more than I have right this minute." Wrong again! Any experimenter may know enough to hook up a feed-back circuit, but it was the imagination of a trained engineer that first conceived the idea that something useful could be accomplished by coupling the grid and plate circuits. Moreover, it is not enough to

R. H. Langley, in charge of the Receiver section of the radio department of the General Electric Company who produce the Radiolas, is a graduate of Columbia University. He has been an engineer with the Wireless Improvement Company, the Marconi Company, and has been with G. E. Co. the past four years. He has taken out several patents covering specific features of radio design

invent, for the fundamental idea is of little value until it is expanded into the widest usefulness. If Fleming had added a grid to his valve, it would have been an audion. If De Forest had connected his audion differently, he would have set up oscillations, and if Armstrong had controlled the oscillation in one tube by means of varying the plate current in another tube, he would have invented the modulating system contributed by Heissing.



Laboratory testing of receiving apparatus

These men were not merely experimenters. They had educated imaginations capable of conceiving that particular ends might be achieved by certain means. We have been taught that high power, transmitted at long wavelength, was necessary for transmission across the Atlantic, but Frank Conrad built a special set, of low power, operating not on twenty thousand meters or even six hundred meters, but on one hundred meters, a wavelength below that used by amateur stations, and his set was picked up in England with sufficient volume so that it was possible to re-transmit the speech and music from English broadcasting stations.

The untrained imagination of an experimenter would not have prompted such an attempt. On the other hand, it would have accepted the general understanding that it was impossible.

But suppose you do go through the six years of college. What then? You leave with a training that has fitted you for radio research work, but what does that mean? That you know everything about radio? By no means! You know the radio of the laboratory and such practical phases as you may have interested yourself in particularly. The problem is in finding a place where your knowledge is wanted. There are only a few of those places.

You may carry on at the university for a year or two as an instructor, where you will have a chance to do work of your own, perhaps of such value that the returns from it will provide a sizable income. You may act as a consulting engineer for radio manufacturers. If, during your years as a student, you have established a reputation by writing for the technical publications, you can maintain a general consulting practice.

All the larger concerns connected with radio, such as the General Electric, Western Electric, and American Telephone and Telegraph, have opportunities for radio engineers who can handle research problems, some of which are directly concerned with products to be manufactured, or which are involved in manufacturing, while others are intended to supply information and knowledge on matters which seem, at the time, unrelated.

Some research workers grow into the laboratory, while others grow out of it. That is largely dependent upon the personality of the individual. Success, which is a point of view, may come equally to the man who loses himself in the research laboratory, or who becomes prominent in the public mind, perhaps as a chief engineer or as an executive leader in a new scientific achievement.

You have no reason to fear that you will be unable to make use of your training if you really become a radio engineer, for the number who can carry on through those six years at college is all too few. They are difficult years, trying the ability and the strength of purpose to the limit, making the title of Radio Engineer well earned and valuable to hold.

There is no crowding at the top of the ladder in this profession because, of thousands of radio experimenters who think they would like to be engineers, only one wants to make the grade hard enough to be willing to work and make the sacrifices which are required. If you do carry through

(*Continued on page* 82)

A HIGHLY EFFICIENT SHORT-WAVE RECEIVER

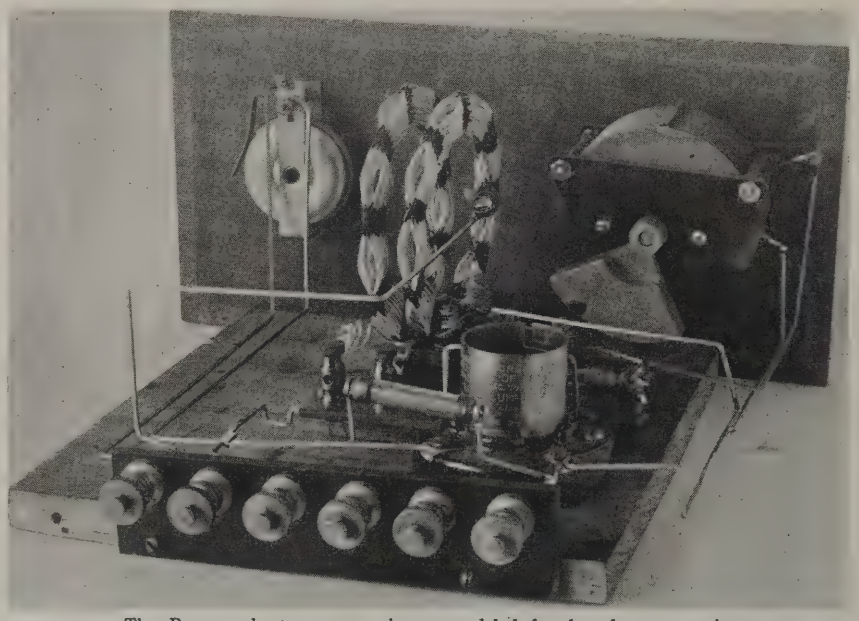
A "Golden Rule" Set That Is Also Adaptable To Broadcast Reception With Excellent Results

By R. B. Bourne

The outstanding features of this tuner are great selectivity, exceptional signal strength with but one stage of audio frequency amplification—remarkable ease of adjustment—Two controls!—Practically non-radiating because of an untuned antenna circuit. This makes it impossible to bring the secondary circuit into resonance with the antenna which brings about re-radiation.

IN choosing a design for a short wave receiver, several things must be taken into consideration. Among these the most important are wavelengths to be covered, high efficiency, freedom from vagrant capacity effects and ease of control.

The receiver herein described was designed especially for the recent trans-Atlantic receiving tests. Although the wavelength range of the receiver is from about 80 to 220 meters, it will be shown later on in this article how this remarkable tuner can be easily changed to cover the 220-550 broadcasting wave band with excellent results. All the well known types of receiving circuits were considered, from the superheterodyne to the single circuit regenerative tuner. The superheterodyne was the only circuit using radio frequency amplification which was favorably considered, but there was no time in which to build one, as the tests were already under way.



The Bourne short wave receiver remodeled for broadcast reception

Experience with many types of receivers had shown the writer that where the time for making best adjustments is limited, as in amateur relay work, the best results are to be expected from a tuner with two controls at the most. A further advantage might be expected if one of these adjustments were to be very broad so as to hold for a relatively wide band of wavelengths.

Accordingly the circuit chosen was that shown in the accompanying diagram. It will be seen that this is a three circuit tuner, with an aperiodic or untuned antenna circuit, tuned secondary and ordinary tickler. It might seem at first thought improbable that, with but one stage of audio frequency amplification, signals from European stations could be heard with so simple an arrangement. Nevertheless no less than twenty-seven different European stations were copied, some of them with a signal strength sufficient to enable them to be copied ten feet from the phones. This was particularly the case with f8AB, Nice, France, whose 110-meter signals were copied every night of the tests.

This reception is primarily the result of elimination of all losses possible. Taking each part of the circuit separately, let us see what losses can occur and what can be done to reduce them. We must remember we are dealing with very high frequencies, as the tuner must be capable of tuning well below 100 meters.

The coil system as shown consists of two spiderweb inductances. These are so mounted that the tickler can be rotated with respect to the antenna and secondary coil. The secondary must tune from about 80 meters to 220 meters. No taps are provided, the whole coil being used for every adjustment. Theoretically, stronger signals will be received on a given wavelength when the inductance is high and the capacity small. It will appear therefore that better results on the upper part of the range would be obtained if a larger coil and smaller capacity were used, but we must remember that it is of vital importance to be able to shift quickly from 200 to 100 meters. The reason for this as as follows: Signals from Europe at times fade completely out. It is necessary to be able therefore to cover many different wavelengths and to be able to shift back to any station instantly. This is particularly true when listening for several stations all of which are supposed to be transmitting at the same time. With all this in mind, it was decided that the gain realized from having the best possible ratio of inductance to capacity would be offset by the losses incurred in using switches and the time lost in making adjustments.

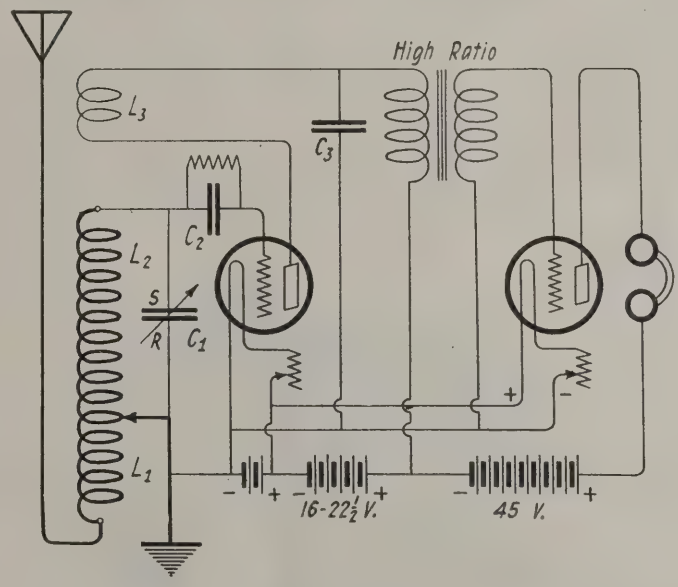
In the diagram, L_1 and L_2, the antenna and secondary coils respectively are wound as one coil. L_1 consists of three turns and L_2 of 15. The coil is made on a form consisting of nine spokes made from six-inch spikes driven into a wooden hub. Holes are first bored in the hub making the withdrawal of the spikes easy. The hub is two inches in diameter. Enough cord is wound on this form to make the diameter two and three-quarter inches. The purpose of the cord is to make the removal of the coil from form easy, as it drops off when the winding is complete and the spokes removed.

We start winding from the high potential end and wind on 15 turns of number 22 D.C.C. wire. At this point the wire is looped and twisted for the

ground tap. The insulation is bared close to the coil and the wires soldered. Three more turns are then wound on, in the same direction. This brings the antenna tap of the coil on the outside. The reason for this is that with the antenna and ground turns outside of the secondary, the latter is shielded by the winding itself and if the coil is mounted so that its plane is at right angles to the panel, no capacity effect from the hand will be noticed, on this account. When the winding is finished it is made rigid so that it can be removed from the spokes and be self-supporting.

Varnishing or dipping such a coil into collodion increases its capacity which defeats in a measure the purpose of the spiderweb method of winding. We must keep the insulation high and make the coil rigid and yet not increase the capacity of the windings appreciably. The best dielectric known is air and we rely on air for both insulation and low loss dielectric, excepting where the turns cross in the spiderweb. It is at this point where moisture may be in the insulation on the wire and cause leakage. Accordingly we bake it out and make the coil rigid by running into the winding molten shellac. Pure flake shellac is pulverized and a small quantity spread on the winding where the turns weave in and out. A moderately hot iron is then used to melt the shellac and impregnate the windings at this point. The iron is kept on until the shellac no longer bubbles showing that the moisture present has been boiled out. No more shellac is used than is necessary to thoroughly impregnate the criss cross point. When the shellac cools it will be found to be extremely hard and the coil may now be removed from the form, and any bare spots on the inside touched up with the hot iron.

In constructing receiving sets nowadays the average man pays more attention to adding three or four tubes to his set in an endeavor to reach out, than he does to cutting down losses in his tuning apparatus and the selection of his tuning instruments. For instance, a simple regenerative set was made up using a well known—though not very efficient variable condenser to tune the secondary with. A log was made of the stations heard and their respective audibility. Then this condenser was removed and another substituted in its place. This second condenser had exceptionally low losses and while it cost perhaps a dollar more, the log of the same receiver using this condenser showed that the selectivity was greatly enhanced and the audibility on distant as well as local stations was much greater, about thirty stations being logged that were absolutely inaudible with the other. This proved unquestionably that when care is used in the selection of the various elements in your set better results can be counted on.



Circuit diagram of the receiver that tuned in twenty-seven different European stations

The tickler coil is wound on the same form and consists of 20 turns of the same size wire. Flexible leads are soldered to the tickler terminal wires. The tickler is mounted on a hinged support made of thoroughly seasoned mahogany. An elliptically shaped dowel is made to fit into one of the open spaces around the edge of the coil and the dowel fitted to the wooden shaft which extends through the panel and is fitted with a knob. The antenna and secondary winding is mounted in the same manner and the two so arranged that the coupling may be varied by turning the tickler. The polarity of the tickler is best determined by trial.

The next and probably the most important part of the circuit from the standpoint of losses which may exist is the variable condenser. It is of .0005 mfd. capacity and was chosen because of its rigid construction and very low losses. Hard rubber is the solid dielectric used. The rotary plates and shaft are grounded, thereby eliminating further losses and body capacity effects. This condenser will tune the secondary inductance from 80 to about 220 meters. To check the efficiency of your condenser, substitute others in its place. Some condensers will render inaudible signals on 100 meters which with a good condenser are entirely readable.

The grid condenser is of about .0002 mfd. and is made up of three sheets of copper foil with mica dielectric. The active surface of the plates is about ¾ inches square. The grid leak was found by trial to be 1.5 megohms.

C_3 is a by-pass condenser and is of mica with a capacity of .001 mfd. This is connected from the battery side of the tickler direct to ground so that no radio frequency passes through the B batteries and phone cords.

The whole arrangement was mounted behind a piece of thoroughly seasoned wood. The variable condenser is mounted in the usual way. Terminals are brought out in the rear on a small subpanel of hard rubber.

One point of importance is the wiring. Air is used for insulation as much as possible and the wiring is so arranged that the shortest possible lengths are used. Square copper bus is employed as this lends itself to neat wiring and is rigid. Soldering of joints is very important in keeping the set quiet. The flux used is rosin dissolved in alcohol. Dry rosin is O. K. but harder to work with. The iron must be hotter than when using paste. Rosin flux has the additional advantage of forming a protective coating over the joint soldered.

This set was used in conjunction with an antenna 30 feet high and 60 feet long, a single copper wire. It is important that all joints in the antenna be soldered. It is better and not difficult to bring the antenna wire right into the set itself. The fewer insulators used the better. We have to deal with very weak signals of extremely high frequency and no precautions must be overlooked. A loose connection in either the antenna or ground system may introduce high enough resistance to render wasted all the other precautions taken.

It is found in tuning that the tickler may be turned out as far as possible for 100-meter work and regeneration controlled nicely by the filament rheostat. For 200-meter work, the tickler must be brought up close to the secondary. It is not necessary to change this adjustment for a range of wavelengths between 160 and 220, leaving the receiver uni-controlled for this range. The set oscillates nicely over

It might seem improbable that, with only one stage of audio frequency amplification, European stations could be heard with this simple hook-up. Nevertheless, twenty-seven stations in Europe were heard with it.

(*Continued on page 74*)

Königswusterhausen

(*Continued from page* 43)

To get the highest possible efficiency now, the aerial and earth are conducted across a special self-induction coil with variable collector and two parallel block condensers to the two electrodes of the arc (connection Herzog). The aerial output is considerably increased in this way. By joining an intermediate circuit a sharp tuning of the sender and an absolute freedom from harmonics is obtained.

The new operating method, which is used today in each and every Lorenz-Poulsen sender, is based upon the total checking of the aerial current as far as the zero value because of increased damping. Operating is accomplished by directing the current in the auxiliary magnetization circuit. The coil is employed in a peculiar connection.

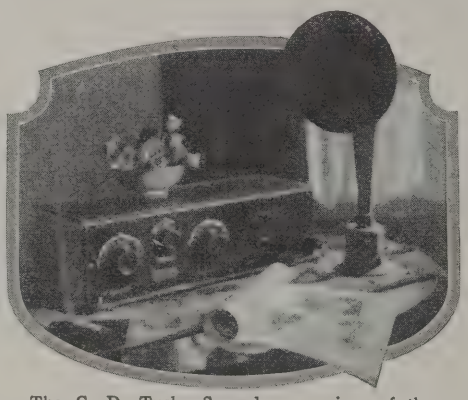
The new telephony method also employs the magnetic influencing coil. As early as in the year 1913, the first trials were made with the new telephony method. Till then the energy in the Poulsen transmitters had been directed immediately to the aerial by microphones connected in parallel, but it became clear that this method could not be used with efficiency as the number of microphones became too great and the synchronous use of them was impossible. Therefore, Dr. Pungs elaborated a system which, for transmitting the oscillations of the sound to the aerial, uses a coil with an iron core. In this method the coil with a particular iron core is connected to the aerial. The speaking and telephony current is conducted to it by means of the microphone and special amplifier-devices. By this varying current the iron alters its magnetic resistance and therefore the current in the aerial. In this way it is possible to control any energy in the aerial by a single microphone. The energy in the aerial varies according to the size of the station by 10, 20, or more H. P. in time intervals which may amount to fractions of 1/1000 of a second, owing to the sounds of the speech.

In the course of time there has been used at Königswusterhausen a good many senders of small and gradually increased energy. Already in 1919, it was possible to transmit, by means of a small arc-generator with an aerial energy of about 3 kilowatts, telephonic communications as well as concerts, which were received with clearness at Moscow, a distance of 1,700 kilometers. In June, 1921, the play of the great opera in Berlin was transmitted to the whole of central Europe. For this purpose small microphones were installed at the stage boxes. The music and singing excited the microphones, and were thus transferred over the wires to the radio station at Königswusterhausen. Here they were imposed on the 4-kilowatt sender and radiated into space.

From nearly all countries in Europe the perfect reception of the wireless opera was confirmed. In August, 1921, the first wireless conversation was carried out from a subscriber's apparatus in Berlin over the normal lines to Königswusterhausen and thence by radio.

By these and other successes, which followed rapidly, it was proved that the arc transmitting system could work in the same way as the high-frequency and the tube system. As a result the station of Königswusterhausen was completed for telephonic and telegraphic transmission.

At present it contains a great number of arc senders and a corresponding number of aerials. The smaller of its senders — partly tube senders — are used for the German traffic. The two arc senders of 10-kilowatt (aerial-energy) for a wave-length of 2,600 to 9,000 meters and 32-kilowatt (aerial-energy) for a wave-length of 4,000 to 20,000 meters are for the European traffic, the latter one also for the traffic with Asia. A further great arc-sender of 50-kilowatts will be built and transferred later on into a new building.



The C. D. Tuska Superdyne receiver of the type described on page 34, installed in home surroundings

Survey of the Ether

(*Continued from page* 47)

which indicates the field strength in thousandths of volts per meter. The average crystal receiving set requires a field strength of approximately 10 of these units for satisfactory operation, while a sensitive vacuum tube receiver may operate with field strengths ranging from ½ to as little as 1/10 of a unit.

If the progress of ether waves was not affected by man-made obstructions and better transmission over water, each volume level of reception would be indicated by a perfect circle with WEAF as its center. But the panorama indicates very clearly the effect of various surface conditions. The tall buildings in the Times Square area cause a heavy dent inward so that the distance from WEAF to the 100 millivolt circle pointing northward is less than one-quarter the distance east and west. The absence of high buildings directly east and west of the station and the improved transmission over the surface of the water, considerably elongates the curve.

The curves indicating field strengths of 75, 50, 41, 30 and 20 millivolts all concentrate in the district of high buildings at the lower tip of Manhattan, a distance of two miles. Yet slightly to the west of this direction, where the waves travel largely over the water, the same 20 millivolt circle extends so as to include practically all of Bayonne, New Jersey, some points on the circle being a distance of nearly 10 miles from WEAF; as compared with but two miles in the direction of the Battery.

Another interesting area is that indicating the poor reception in Central Park. The southern end of Central Park is but six miles distant from WEAF, yet because of the tall apartment buildings surrounding it, there is a remarkable reduction in the energy received. The southern end of the park is on the circle indicating a level of 7.5 units. This falls rapidly to 5 units, then a few hundred yards further north to 2½, 2, 1½, and finally at the center of the park to a level of reception of but one millivolt per meter.

At greater distances it was found that the city of Newark is on a level of 10 units reception. Directly west of Newark there is a large inward indentation, showing the influence of the steel buildings in Newark on reception beyond. Messrs. Bown and Gillett, however, draw the conclusion that such effects are quite local. They are radio shadows, which, like the shadows caused by tall buildings as the sun sets, have but little or no effect on the illumination over very large areas. As a result, curves such as those just given are only of local interest and do not give any indication of how clearly more distant receiving sets will hear a broadcasting station. They should not be interpreted as meaning that a receiving set many miles behind a row of tall buildings will be seriously affected by their presence. Only high mountain ranges and large bodies of water, and immediate local conditions need be considered in judging the possibility of receiving from a particular direction.

It is to be hoped that more extensive data will be collected in the future. The work already done has proved such a revelation and developed so many interesting facts, that further investigation is sure to bring out much additional evidence as to how ether waves travel and what conditions obstruct their progress.

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Newhouse Hotel .....Salt Lake City, Utah	360
KDYM	Savoy Theater .....San Diego, Calif.	250
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYW	Smith Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin .....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co. .....Seattle, Wash.	270
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing.....Denver, Colo.	360
KDZR	Bellingham Publishing Co...Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co...Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co....Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co. .....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and The Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral .....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	238
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)...Billings, Mont.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agricultural College....Corvallis, Ore.	360
KFDL	Knight-Campbell Music Co.....Denver, Colo.	360
KFDO	H. Everett Cutting.....Bozeman, Mont.	248
KFDR	Bullock's Hdw. & Sporting Goods, York, Nebr.	360
KFDV	Gilbrech & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engs., St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendeleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Markshefiel Motor Co....Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iawo	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphey.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co..Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford Univ., Calif.	360
KFGL	Arlington Garage .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Radio & Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co.....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seattle, Wash.	283
KFHS	Clifford J. Dow.....Lihue, Hawaii	275
KFHX	Robert W. Nelson.....Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.).....Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage.....Iola, Kans.	246
KFIF	Benson Polytechnic Institute.....Portland, Ore.	360
KFIL	Windisch Elec. Farm Eqip. Co., Louisburg, Kans.	234
KFIO	North Central High School....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fond-du-lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash.	270
KFJF	National Radio Mfg. Co..Oklahoma City, Okla.	252
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co....Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.....Ottumwa, Iowa	242
KFJM	University of North Dakota..Grand Forks, N. D.	280
KFJQ	Electric Construction Co..Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112th Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray.....Butte, Mont.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co....Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KFMT	George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Saterén.....Houghton, Mich.	266
KFMX	Carleton College .....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club.....Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr.....Corsicana, Tex.	234
KFNF	Henry Field Seed Co.....Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop....Warrensburg Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co.....Helena, Mont.	261
KFNZ	Royal Radio Co.....Burlingam, Calif.	231
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFOB	Glenwood Technical Assn., Minneapolis, Minn.	224
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow .....Portland, Ore.	283
KFOJ	Moberly High School Radio Club..Moberly, Mo.	246
KFOL	Leslie M. Schafbuch.....Marengo, Iowa	234
KFON	Echophone Radio Shop.....Long Beach, Calif.	234
KFOP	Willson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service..Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times-Mirror Co. .....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	360
KJR	Northwest Radio Service Co.....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Calif.	273
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	263
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	360
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch .....St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif., Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co.....San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co., Modesto, Calif.	252
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co..Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZN	The Deseret News.....Salt Lake City, Utah	360
KZV	Wenatchee Bat. & Motor Co, Wenatchee, Wash.	360
WAAB	Valdemar Jensen .....New Orleans, La.	268
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	288
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	John B. Lawrence.....Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.....Bangor, Me.	240
WABK	First Baptist Church.....Worcester, Mass.	252
WABL	Connecticut Agricultural College....Storrs, Conn.	283
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WABP	Robert F. Weinig.....Dover, Ohio	266
WABQ	Haverford College Radio Club.....Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church..New Orleans, La.	263
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAD	Sterling Electric Co.....Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBE	Alfred R. Marcy.....Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya .....Mattapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBI	Indianapolis Radio Club.....Indianapolis, Ind.	234
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co., Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook .....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Associations....Rossville, N. Y.	244
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	224
WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222
WBBY	Washington Light Infantry....Charleston, S. C.	268
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227
WBL	T. & H. Radio Co.....Anthony, Kans.	261
WSB	D. W. May (Inc.).....Newark, N. J.	360
WBT	Southern Radio Corporation....Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel..... Houston, Tex.	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp. of Texas, San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.	250

WCAT	South Dakota State School of Mines, Rapid City, S. Dak.	240
WCAU	Durham & Co. Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co. Little Rock, Ark.	360
WCAX	University of Vermont. Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co. Milwaukee, Wis.	261
WCAZ	Carthage College Carthage, Ill.	246
WCBA	Charles W. Helmbuch. Allentown Pa.	280
WCBC	University of Michigan. Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva. Zion, Ill.	345
WCBE	Uhalt Radio Co. New Orleans, La.	263
WCBG	Howard S. Williams. Pascagoula, Miss.	254
WCBH	University of Mississippi. Oxford, Miss.	242
WCK	Stix-Baer & Fuller Dry Goods Co. St. Louis, Mo.	360
WCM	University of Texas. Austin, Tex.	360
WCX	Detroit Free Press. Detroit, Mich.	517
WDAE	Tampa Daily Times. Tampa, Fla.	360
WDAF	Kansas City Star. Kansas City, Mo.	411
WDAG	J. Laurance Martin. Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South), El Paso, Tex.	268
WDAK	The Courant Hartford, Conn.	261
WDAO	Automotive Electric Co. Dallas, Tex.	360
WDAP	Board of Trade. Chicago, Ill.	360
WDAR	Lit Brothers. Philadelphia, Pa.	395
WDAS	Samuel A. Waite. Worcester, Mass.	360
WDAU	Slocum & Kilburn. New Bedford, Mass.	360
WDAY	Radio Equipment Corporation, Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co. Lancaster, Pa.	258
WDM	Church of the Covenant. Washington, D. C.	234
WDZ	James L. Bush. Tuscola, Ill.	278
WEAA	Frank D. Fallain. Flint, Mich.	250
WEAF	American Tel. & Tel. Co. New York, N. Y.	492
WEAH	Wichita Board of Trade. Wichita, Kans.	280
WEAI	Cornell University Ithaca, N. Y.	286
WEAJ	University of South Dakota. Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co. Providence, R. I.	273
WEAO	Ohio State University. Columbus, Ohio	360
WEAP	Mobile Radio Co. Mobile, Ala.	360
WEAR	Baltimore American and News Publishing Co., Baltimore, Md.	360
WEAS	Hecht Co. Washington, D. C.	360
WEAU	Davidson Bros. Co. Sioux City, Iowa	360
WEAY	Iris Theater Houston, Tex.	360
WEB	Benwood Co. St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co. Houston, Tex.	360
WEW	St. Louis University. St. Louis, Mo.	261
WFAA	Dallas News and Dallas Journal. Dallas, Tex.	476
WFAB	Carl F. Woese. Syracuse, N. Y.	234
WFAH	Electric Supply Co. Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrum't Co., Asheville, N. C.	360
WFAM	Times Publishing Co. St. Cloud, Minn.	360
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College. Cameron, Mo.	360
WFAT	New Columbus College. Sioux Falls, S. Dak.	258
WFAV	University of Nebraska. Lincoln, Nebr.	275
WFI	Strawbridge & Clothier. Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd. Pensacola, Fla.	360
WGAQ	Glenwood Radio Corporation. Shreveport, La.	252
WGAW	Ernest C. Albright. Altoona, Pa.	261
WGAZ	South Bend Tribune. South Bend, Ind.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett. Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co. Buffalo, N. Y.	319
WGV	Interstate Electric Co. New Orleans, La.	242
WGY	General Electric Co. Schenectady, N. Y.	380
WHA	University of Wisconsin. Madison, Wis.	360
WHAA	State University of Iowa. Iowa City, Iowa	484
WHAB	Clark W. Thompson. Galveston, Tex.	360
WHAD	Marquette University. Milwaukee, Wis.	280
WHAG	University of Cincinnati. Cincinnati, Ohio	222
WHAH	Hafer Supply Co. Joplin, Mo.	283
WHAK	Roberts Hardware Co. Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music), Rochester, N. Y.	283
WHAP	Otta and Kuhns. Decatur, Ill.	360
WHAR	Paramount Radio & Elec, Co., Atlantic City, N. J.	231
WHAS	Courier-Journal and Louisville Times, Louisville, Ky.	400
WHAV	Wilmington Elecl. Spec. Co., Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute. Troy, N. Y.	380
WHB	Sweeney School Co. Kansas City, Mo.	411
WHK	Radiovox Co. Cleveland, Ohio	283
WHN	George Schubel New York, N. Y.	360
WIAB	Joslyn Automobile Co. Rockford, Ill.	252
WIAC	Galveston Tribune Galveston, Tex.	360
WIAD	Howard R. Miller. Philadelphia, Pa.	254
WIAF	Gustav A. DeCortin. New Orleans, La.	234
WIAI	Heer Stores Co. Springfield, Mo.	252
WIAJ	Fox River Valley Radio Sup. Co., Neenah, Wis.	224
WIAK	Journal-Stockman Co. Omaha, Nebr.	278
WIAO	School of Eng'g of Milwaukee, Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co. Marion, Ind.	226
WIAR	Paducah Evening Sun. Paducah, Ky.	360
WIAS	Home Electric Co. Burlington, Iowa	360
WIAU	American Trust & Savings Bank. Le Mars, Iowa	360
WIK	K. & L. Electric Co. McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co. Washington, D. C.	360
WIP	Gimbel Bros. Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories, Waco, Tex.	360
WJAF	Muncie Press and Smith Elec. Co., Muncie, Ind.	360
WJAG	Norfolk Daily News. Norfolk, Nebr.	283
WJAK	Clifford L. White. Greentown, Ind.	254
WJAM	D. M. Perham. Cedar Rapids, Iowa	268
WJAN	Peoria Star Peoria, Ill.	280
WJAQ	Capper Publications Topeka, Kans.	360
WJAR	The Outlet Co. Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250
WJAT	Kelley-Vawter Jewelry Co. Marshall, Mo.	360
WJAX	Union Trust Co. Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory. Chicago, Ill.	448
WJD	Denison University Granville, Ohio	229
WJH	William P. Boyer Co. Washington, D. C.	273
WJX	Deforest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corporation of America. New York, N. Y.	405
WJZ	Radio Corporation of America. New York, N. Y.	455
WKAA	H. F. Paar. Cedar Rapids, Iowa	268
WKAD	Charles Looff (Crescent Park), E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co. Wichita Falls, Tex.	360
WKAN	United Battery Service Co. Montgomery, Ala.	226
WKAP	Dutee W. Flint. Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College, East Lansing, Mich.	280
WKAV	Laconia Radio Club. Laconia, N. H.	254
WKAY	Brenau College Gainesville, Ga.	280
WKY	WKY Radio Shop. Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation, Minneapolis, Minn.	417
WLAH	Samuel Woodworth Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co. Waco, Tex.	360
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co. Tulsa, Okla.	360
WLAP	W. V. Jordon. Louisville, Ky.	360
WLAQ	Arthur E. Schilling. Kalamazoo, Mich.	283
WLAV	Electric Shop Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y., New York, N. Y.	360
WLAX	Putnam Electric Co. Greencastle, Ind.	231
WLB	University of Minnesota. Minneapolis, Minn.	360
WLW	Crosley Mfg. Co. Cincinnati, Ohio	309
WMAB	Radio Supply Co. Oklahoma, Okla.	360
WMAC	Clive B. Meredith. Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp. Dartmouth, Mass.	360
WMAH	General Supply Co. Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co. Kansas City, Mo.	275
WMAK	Norton Laboratories Lockport, N. Y.	360
WMAL	Trenton Hardware Co. Trenton, N. J.	256
WMAN	First Baptist Church. Columbus, Ohio	286
WMAP	Utility Battery Service. Easton, Pa.	246
WMAQ	Chicago Daily News. Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute. Auburn, Ala.	250
WMAW	Wahpeton Electric Co. Wahpeton, N. Dak	254
WMAY	Kingshighway Presby. Church, St. Louis, Mo.	280
WMAZ	Mercer University Macon, Ga.	268
WMC	Commercial Appeal Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co. Washington, D. C.	261
WNAC	Shepard Stores Boston, Mass.	278
WNAD	University of Oklahoma. Norman, Okla.	360
WNAL	R. J. Rockwell. Omaha, Nebr.	266
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.	286
WNAP	Wittenberg College Springfield, Ohio	275
WNAQ	Charleston Radio Elec. Co. Charleston, S. C.	360
WNAR	C. C. Rhodes. Butler, Mo.	231
WNAS	Texas Radio Corp. and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Brothers Co. Philadelphia, Pa.	236
WNAV	Peoples Tel. & Teleg. Co. Knoxville, Tenn.	236
WNAW	Henry Kunzman. Box 167, Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co. Yankton, S. Dak.	244
WNJ	Shotton Radio Mfg. Co. Albany, N. Y.	360
WOAC	Page Organ Co. (H. P. Maus). Lima, Ohio	266
WOAD	Friady Battery & Electric Corp. Sigourney, Iowa	360
WOAE	Midland College. Fremont, Neb.	360
WOAF	Tyler Commercial College. Tyler, Tex.	360
WOAG	Appolio Theatre. Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation. Charleston, S. C.	360
WOAI	Southern Equipment Co. San Antonio, Tex.	385
WOAN	James D. Vaughn. Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co. Mishawaka, Ind.	360
WOAP	Kalamazoo College. Kalamazoo, Mich.	283
WOAR	Henry P. Lundskow. Kenosha, Wis.	229
WOAT	Boyd M. Hamp. Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 112th Inf. Erie, Pa.	242
WOAW	Woodmen of the World. Omaha, Neb.	526
WOAX	Franklyn J. Wolff. Trenton, N. J.	240
WOC	Palmer School of Chiropractic. Davenport, Iowa	484
WOI	Iowa State College. Ames, Iowa	360
WOK	Pine Bluff Co. Pine Bluff, Ark.	360
WOO	John Wanamaker. Philadelphia Pa.	509
WOQ	Western Radio Co. Kansas City, Mo.	360
WOR	L. Bamberger & Co. Newark, N. J.	405
WOS	Missouri State Market'g Bu. Jefferson City, Mo.	441
WPAB	Pennsylvania State College. State College, Pa.	283
WPAC	Donaldson Radio Co. Okmulgee, Okla.	330
WPAH	Wisconsin Dept. of Markets. Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp. New Haven, Conn.	268
WPAK	North Dakota Agricultural College, Agricultural College, N. Dakota	360
WPAL	Avery & Loeb Electric Co. Columbus, Ohio	286
WPAM	Auerbach & Guettel. Topeka, Kans.	360
WPAP	Theodore D. Phillips. Winchester, Ky.	360
WPAQ	General Sales & Engineering Co. Frostburg, Md.	360
WPAT	St. Patrick's Cathedral. El Paso, Tex.	360
WPAU	Concordia College. Moorhead, Minn.	360
WPAZ	John R. Koch. Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr. Parkesburg, Pa.	360
WQAC	E. B. Gish. Amarillo, Tex.	360
WQAD	Whitall Electric Co. Waterbury, Conn.	242
WQAE	Moore Radio News Station. Springfield, Vt.	275
WQAF	Sandusky Register. Sandusky, Ohio	240
WQAL	Coles County Telep. & Teleg. Co. Mattoon, Ill.	258
WQAM	Electrical Equipment Co. Miami, Fla.	283
WQAN	Scranton Times. Scranton, Pa.	280
WQAO	Calvary Baptist Church. New York, N. Y.	360
WQAQ	W. Texas Radio Co. (Abilene Daily Reporter) Abilene, Texas	360
WQAS	Prince-Walter Co. Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.). Greenville, S. C.	258
WQAW	Catholic University. Washington, D. C.	236
WQAX	Radio Equipment Co. Peoria, Ill.	360
WRAA	Rice Institute. Houston, Texas	360
WRAD	Taylor Radio Shop. Marion, Kans.	248
WRAF	The Radio Club. Laporte, Ind.	224
WRAH	Stanley N. Read. Providence, R. I.	231
WRAL	Northern States Power Co. St. Croix Falls, Wis.	248
WRAM	Lombard College. Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co. Waterloo, Iowa	236
WRAO	St. Louis Radio Service Co. St. Louis, Mo.	360
WRAV	Antioch College. Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop. Reading, Pa.	238
WRAX	Flexon's Garage. Gloucester City, N. J.	268
WRAY	Radio Sales Corporation. Scranton, Pa.	280
WRAZ	Radio Shop of Newark. Newark, N. J.	233
WRC	Radio Corporation of America, Washington, D. C.	469
WRK	Doron Bros. Electrical Co. Hamilton, Ohio	360
WRL	Union College. Schenectady, N. Y.	360
WRM	University of Illinois. Urbana, Ill.	360
WRR	City of Dallas, Police and Fire Signal Dept. Dallas, Texas	360
WRW	Tarrytown Radio Res'rch Lab., Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College, Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural Col., Clemson College, S. C.	360
WSAD	J. A. Foster Co. Providence, R I.	261
WSAG	Loren V. Davis and George Prestman, Sr., St. Petersburg, Fla.	244
WSAH	A. G. Leonard, Jr. Chicago, Ill.	248
WSAI	United States Playing Card Co., Cincinnati, O.	309
WSAJ	Grove City College. Grove City, Pa.	360
WSAL	Franklin Electric Co. Brookville, Ind.	246
WSAN	Allentown Radio Club. Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co. Plainview, Tex.	268
WSAW	John J. Long, Jr. Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory. Chicago, Ill.	268
WSAY	Port Chester Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop. Pomeroy, Ohio	258
WSB	Atlanta Journal. Atlanta, Ga.	429
WSL	J. & M. Electrical Co. Utica, N. Y.	273
WSY	Alabama Power Co. Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co. Fall River, Mass.	248
WTAC	Penn Traffic Co. Johnstown, Pa.	360
WTAF	Louis J. Gallo. New Orleans, La.	268
WTAG	Kern Music Co. Providence, R. I.	258
WTAH	Carmen Ferro. Belvidere, Ill.	236
WTAJ	The Radio Shop. Portland, Me.	236
WTAL	Toledo Radio & Electric Co. Toledo, Ohio	252
WTAM	Willard Storage Battery Co. Cleveland, O.	390
WTAP	Cambridge Radio & Electric Co. Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son. Osseo, Wis.	254
WTAR	Reliance Electric Co. Norfolk, Va.	280
WTAS	Charles E. Erbstein. Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co. Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co. Tecumseh, Nebr.	360
WTAW	Agricultural and Mechanical College of Texas, College Station, Tex.	280
WTAX	Williams Hardware Co. Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcast. Sta., Oak Park, Ill.	283
WTAZ	Thomas J. McGuire. Lambertville, N. J.	283
WTG	Kansas State Agri. Coll. Manhattan, Kans.	360
WWAB	Hoenig, Swern & Co. Trenton, N. J.	226
WWAC	Sanger Bros. Waco, Tex.	360
WWAD	Wright & Wright (Inc.). Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley. Joliet, Ill.	227
WWAF	Galvin Radio Supply Co. Camden, N. J.	236
WWAO	Michigan College of Mines. Houghton, Mich.	244
WWI	Ford Motor Co. Dearborn, Mich.	273
WWJ	Detroit News. Detroit, Mich.	517
WWL	Loyola University. New Orleans, La.	280

Canadian Stations

CFAC	The Calgary Herald. Calgary, Alta.	430
CFCA	Star Publishing & Printing Co. Toronto, Ont.	400
CFCF	Marconi Wireless Telegraph Co. of Canada, Montreal, Que., Canada	440
CFCH	Abitibi Power & Paper Co. Iroquois Falls, Ont.	400
CFCJ	La Cie. de L'Evenement. Quebec, P. Q.	410
CFCK	Radio Supply Co., Ltd. Edmonton, Atla.	410
CFCL	Centennial Methodist Church. Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd. Calgary, Alta.	440
CFCO	Semmelhaack-Dickson, Ltd. Bellevue, Que.	450
CFCQ	Radio Specialties, Ltd. Vancouver, B. C.	450
CFCR	Laurentide Air Service, Ltd. Sudbury, Ont.	410
CFCW	The Radio Shop. London, Ont.	420
CFDC	Sparks Co. Nanaimo, B. C.	430
CFQC	The Electric Shop, Ltd. Saskatoon, Sask.	400
CFRC	Queens University. Kingston, Ont.	450
CFUC	University of Montreal. Montreal, Que.	400
CFXC	Westminster Trust Co. New Westminster, B. C.	440
CHAC	Radio Engineers. Halifax, N. S.	400
CHBC	The Albertan Publishing Co. Calgary, Alta.	410
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd. Toronto, Ont.	440
CHCD	Canadian Wireless & Elec. Co., Quebec, Que.	410
CHCE	Western Canada Radio Supply. Victoria, B. C.	400
CHCL	The Vancouver Merchants Exchange, Ltd., Vancouver, B. C.	440
CHCM	Riley & McCormack, Ltd. Calgary, Alta.	440
CHCS	The Hamilton Spectator. Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd. Montreal, Que.	341
CJCA	The Edmonton Journal, Ltd. Edmonton, Alta.	450
CJCM	J. L. Phillipe Landry. Monti Joli, Que.	400
CJGC	London Free Press Printing Co. London, Ont.	430
CJCD	The T. Eaton Co., Ltd. Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co. Vancouver, B. C.	420
CJCI	Maritime Radio Corp., Ltd. St. John, N. B.	400
CJCN	Simons Agnew & Co. Toronto, Ont.	410
CJCX	Percival W. Shackleton. Olds, Alta.	400
CJSC	The Evening Telegram. Toronto, Ont.	430
CKAC	La Presse Publishing Co., Ltd. Montreal, P. Q.	425
CKCD	Vancouver Daily Province. Vancouver, B. C.	410
CKCE	Canadian Indp. Telephone Co. Toronto, Ont.	450
CKCH	Canadian National Railways. Ottawa, Ont.	435
CKCK	Leader Publishing Co., Ltd. Regina, Sask.	420
CKCO	Dr. G. M. Geldert (For Ottawa Radio Assn.), Ottawa, Ont.	400
CKCX	P. Burns & Co., Ltd. Calgary, Alta.	440
CKOC	Wentworth Radio Supply Co. Hamilton, Ont.	410
CKY	Manitoba Telephone System. Winnipeg, Man.	450
CFYC	V. W. Odlum. Vancouver, B. C.	400

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower)	2,600
8AJ	Paris	1,780
ESP	Paris	450

Cuban Stations

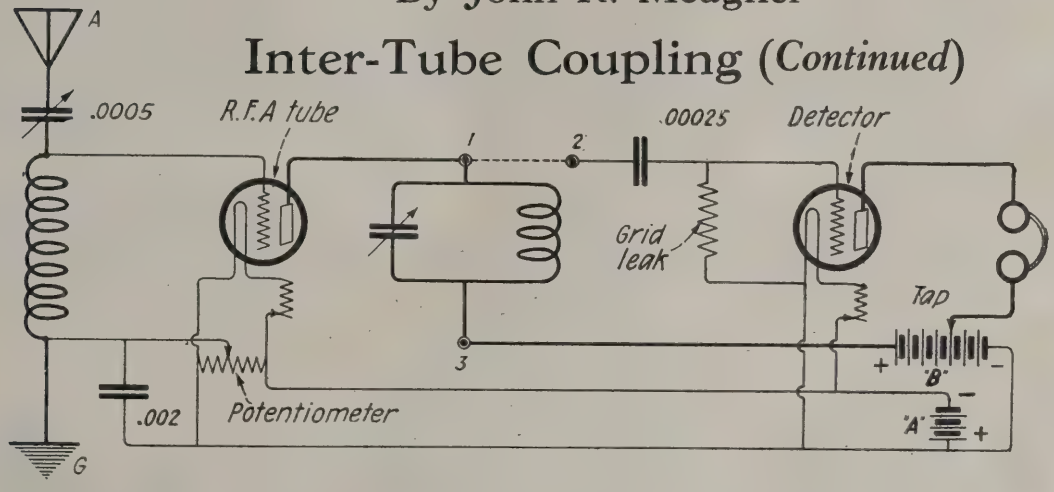
PWX	Cuban Telephone Co. Habana	400
2DW	Pedro Zayas Habana	300
2AB	Alberto S. de Bustamante Habana	240
2OK	Mario Garcia Vélez Habana	360
2BY	Frederick W. Borton Habana	260
2CX	Frederick W. Borton Habana	320
2EV	Westinghouse Elec. Co. Habana	220
2TW	Roberto E. Ramirez Habana	230
2HC	Heraldo de Cuba Habana	275
2LC	Luis Casas Habana	250
2KD	E. Sanchez de Fuentes Habana	350
2MN	Fausto Simon Habana	270
2MG	Manuel G. Salas Habana	280
2JQ	Raul Pérez Falcon Habana	150
2KP	Alvaro Daza Habana	200
2HS	Julio Power Habana	180
2OL	Oscar Collado Habana	290
2WW	Amadeo Saenz Habana	210
5EV	Leopoldo Y. Figueroa Colon	360
6KW	Frank H. Jones Tuinucu	340
6KJ	Frank H. Jones Tuinucu	275
6CX	Antonio T. Figueroa Cienfuegos	170
6DW	Eduardo Terry Cienfuegos	225
6BY	José Ganduxe Cienfuegos	300
6AZ	Valentin Ullivarri Cienfuegos	200
6EV	Josefa Alvarez Caibarién	225
7AZ	Pedro Nogueras Camaguey	225
7BY	Salvador Rionda Camaguey	350
8AZ	Alfredo Broocks Santiago de Cuba	240
8BY	Alberto Ravelo Santiago de Cuba	250
8FU	Andrés Vinnet Santiago de Cuba	225
8DW	Pedro C. Anduz Santiago de Cuba	275
8EV	Edurado Mateos Santiago de Cuba	180
8GT	Juan F. Chibas Santiago de Cuba	260

RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Inter-Tube Coupling (*Continued*)



THOSE students who have built up the test set described in the February *Radio Engineering* may readily make relative tests of the efficiency of different methods of inter-tube coupling by merely adding an extra socket, rheostat and potentiometer to the rest of the equipment and making a few minor changes. Arrange the circuit as shown in the diagram so that there will be one stage of radio frequency amplification with a single circuit aerial connection and a vacuum tube detector.

Provide three Fahnestock clips (1, 2 and 3) in order that any type of coupling system may be connected in the circuit.

Then, while some good broadcasting station is on, try each of the methods of coupling shown on this page last month. Make a note of the results with particular regard to volume.

It should be found that the 'variometer tuned impedance' and the 'condenser tuned impedance' are very much alike. The 'air core choke' (being merely a broad—not definitely tuned—tuned impedance) may be represented by leaving the variometer tuned impedance in one position, that is, not adjusting it for each wave length. If the variometer were wound with resistance wire and had very little distributed capacity it could be used as an untuned air core choke—being adjusted once only to obtain sufficient inductance at the maximum wave length in order to make the RF tube oscillate over the entire range. In this connection, as to the proper value of impedance in the plate circuit, we may point out that an infinitely high value would be best for 'transformer action' but when a certain amount is reached, the RF tube oscillates and it is necessary to use either less impedance or else place a so-called 'looser' in the grid circuit of the first tube—the latter is by far the better plan.

Doubtless the resistance coupling will be found very poor, for wave lengths under 300 meters at least. The iron core choke, when properly designed, differs from the air core choke in that it is broader or presents a high impedance to a greater range of frequencies. We have often heard of the high impedance of telephone receivers to RF variations; if this is true they should make excellent RF inter-tube chokes or couplers. If an extra pair is on hand try them for this purpose—it will be found that they are rather poor and we can thus safely question the necessity for 'by-pass' condensers.

So far we have considered only auto-transformation—where one impedance is common to two circuits—here the grid and plate. A more practicable scheme is inductive transformation—using transformers.

The best type of transformer for any particular frequency would be one in which both the primary and secondary circuits are tuned to that frequency.

The next best type of transformer for any particular frequency would be one in which the secondary is tuned to that frequency and in which the primary has sufficient impedance to secure a voltage variation across its terminals consistent with the maximum possible variation; and this impedance value can safely be lower than the highest value which is infinity—because the voltage variation across the primary does not increase in direct proportion to the impedance.

For untuned transformers to operate over a broad band of frequencies it is necessary to keep the distributed capacity and the circuit capacity as low as possible; otherwise the windings will have well defined peaks and be poor at other frequencies. In designing untuned RF transformers one point has generally been overlooked—that is, the effect of any impedance in the plate circuit upon the grid conductance of the same tube; the static capacity of the grid is much less than the actual capacity when the plate impedance is high.

(*To be continued.*)

THIS is the fourth of a series of articles forming an educational and interesting course in radio fundamentals. Have you followed it from the start? If not, hunt up your back copies and read them thoroughly. Written in the language of the layman, this course started with a few simple instruments: variable condensers, coils and tube accessories—a home laboratory outfit, the use of which, as outlined by Mr. Meagher, teaches the mystery of radio in an easy-to-understand and interesting-to-learn fashion. The author, working on the theory that a principle is more easily understood when a person works it out with his own hands than when it is told to him or when he reads it out of a book, has given a thorough course in fundamental circuits and their operation. The experimenter has a chance then to actually see the results of his experimentations and does not have to depend on the words of others. We sincerely advise all our readers to follow this series and learn radio fundamentals easily and thoroughly. The author, in the first installment, recommended that students of this course supplement his instructions by reference to E. E. Bucher's "Wireless Experimenter's Manual" which is published by the Wireless Press, Inc., also "Radio Communication Pamphlet No. 40" published by the Bureau of Standards.

Selected Radio Hook-Ups

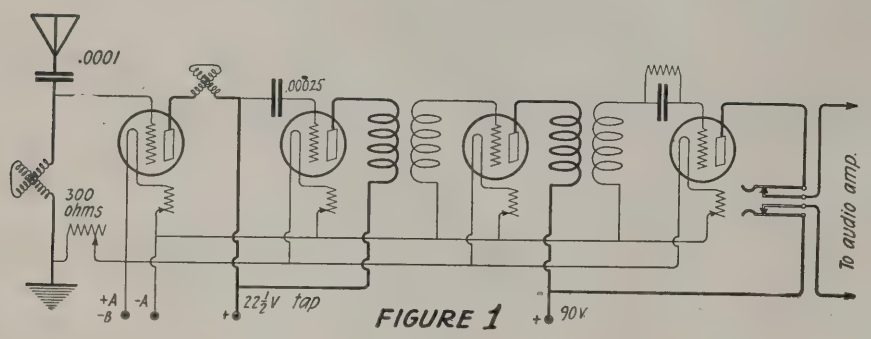


FIGURE 1

FIGURE 1 shows an adaptation of THE WIRELESS AGE Three-Tube Set described in the March issue. Instead of using a crystal for a detector, a standard tube is used, and the output of the Tuned Impedance tube is fed into two stages of the ordinary untuned radio frequency amplification. This comprises a receiver which is almost the utmost in sensitivity. The antenna for use in connection with this set may consist of about 20 feet of No. 18 paraffined bell-wire. It may be found necessary to insert a leak of about one and one-half megohms between the grid of the second tube and its positive filament leg to prevent the tube from blocking.

WE have had many requests from our readers for the Harkness Two-tube Reflex Circuit shown in figure 2. The antenna tuning coil consists of 15 turns of No. 28 DSC wire wound on top of the secondary coil which is wound with 40 turns of the same wire. A piece of 2½" cardboard tubing will suffice as a form for these windings. The Radio Frequency transformer is wound on a similar piece of tubing, the primary having 35 turns instead of 15 and the secondary 40 turns. The circuits are tuned by means of two 23-plate .0005 mfd. variable condensers. The condenser across the secondary of the first audio frequency transformer is a .0005 mfd. fixed.

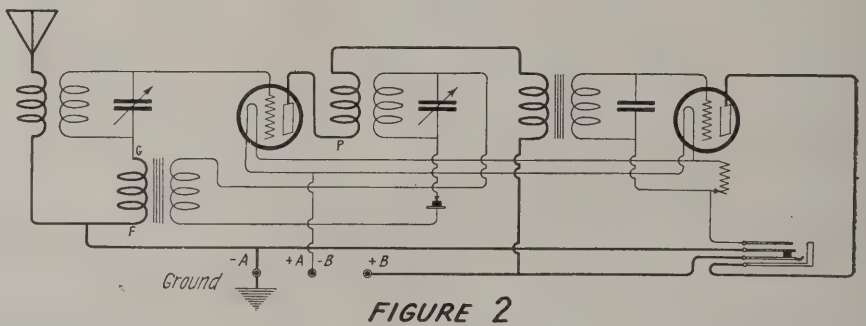


FIGURE 2

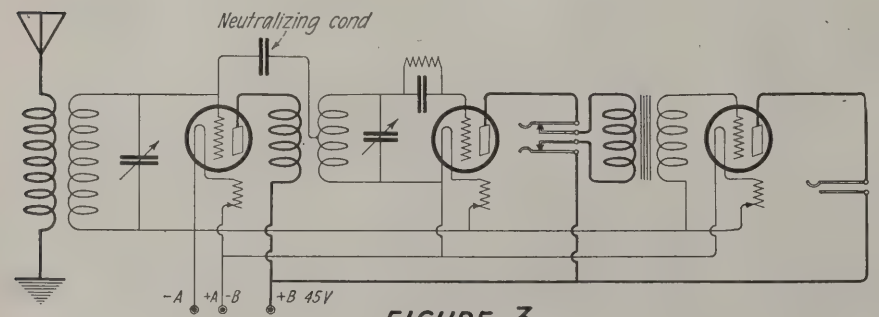


FIGURE 3

FIGURE 3 shows a corking three-tube set along the lines of a neutrodyne, in fact it really is a "one-horse" neutrodyne using just one tuned radio stage with neutralizing condenser, instead of the more common two stage. The two radio frequency transformers consist of 15 turns of No. 22 DCC wound on a 3" form and about ⅜" from this another winding of 50 turns more. In each case the larger winding is shunted by a 23-plate variable condenser and tunes the grid circuit.

IN figure 4 there is shown the hook-up for a very simple regenerative receiver using a detector and one stage of audio frequency amplification. There are only two tuning controls; the secondary condenser and the plate tickler. The tuning unit may be made by removing about 10 turns from the primary of a standard 180° variocoupler and winding in their place about 6 turns of No. 22 DCC wire. This winding forms the primary circuit while the winding from which the 10 turns were removed forms the secondary coil. The rotor of the variocoupler is then used as a tickler coil. This set tunes much more sharply than the old "single circuit" and is every bit as easy to construct. The tuning condenser across the secondary is a 23-plate .0005 mfd. variable.

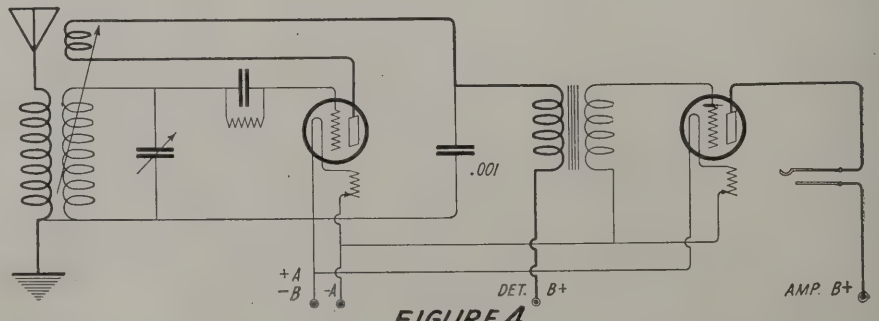
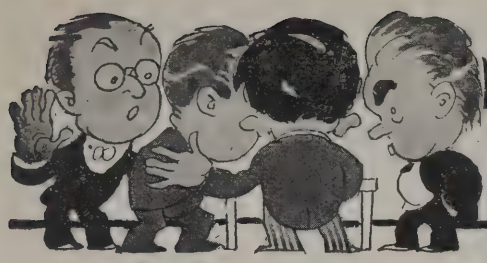


FIGURE 4



NEW APPLIANCES AND DEVICES

K. E. Loud Speaker

THE Kirkman Engineering Corporation, New York City, manufacturers for 10 years of the K. E. line of electrical protective and wiring devices, announces the perfection of a new design radio loud speaker.

Dealers, jobbers, and radio experts declare it unusually faithful in sound reproduction.

"Knowing the limitations of acoustical laws," says a well known New York dealer, "I would unhesitatingly agree that the K. E. Loud Speaker has secured perfection in volume and clarity as far as is humanly possible."

No batteries are used with the K. E. Loud Speaker. An adjustable diaphragm controls the volume and eliminates distortion. The 14-inch bell horn is finished in handsome black crystalline and nickel. The Alpha Electric Company of 151 West 30th Street, New York City, is the distributor of the New York district. The price is $25.00 list.

Mozart Baby Grand Reproducer

THE Mozart-Grand Co. of Newark, N. J., announce the production of a complete line of Mozart Baby Grand, Mozart-Grand and Mozart Concert Grand "reproducers." Shipments have commenced on the Baby Grand.

While instruments of the reflex type, broadly speaking, are not new, the design is entirely original and has been developed with a technical and practical care, probably never previously bestowed on this class of merchandise. Its extraordinary reproducing qualities, its extremely low center of gravity, with resultant steadiness and its general beauty of outline guarantee it a worthy place among all that is superlative in radio necessities today.

The design is certainly original insofar as placing the electrical unit in such an accessible position. The best of these units, like any other piece of delicate mechanism, may require attention at times and if they have to be sent back to their manufacturers, why should it be necessary to return the whole horn or even a heavy and bulky base?

The color scheme is black and gold. The unit and other fittings are heavily gold plated, the combination resulting in a charming effect which will harmonize perfectly with any furnishings from the simplest to the most pretentious.

The dimensions, of the Mozart Baby Grand are: diameter of bell, 12"; height overall, 12½"; length overall, 12½". Price complete with unit and cord, ready for attaching, $10.00.

New Dial Has Ribs for Grip

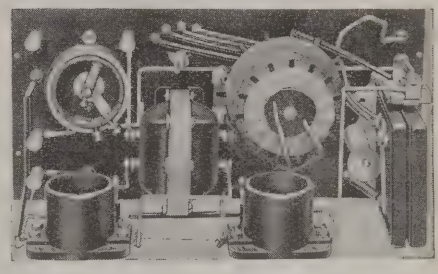
AN innovation in Radion dials has appeared in the form of a dial having a ribbed surface. They are made in black and mahoganite with gold graduations in three and four-inch diameters. The ribs radiate from the knob nearly to the beveled edge and provide easy rests for the fingers when delicate tuning is necessary. A vernier effect is thus obtained, and a very small

motion of the dial may be secured with a considerable movement of the finger tip placed near the periphery.

This dial is equipped, as are other Radion dials, with a semi-circular slot in the back which corresponds to the scale indications and fits a stop peg in the panel, thus preventing damage to internal rotor leads and limiting the dial movement to the semi-circular scale. The metal insert is made to fit a one-fourth-inch shaft, but there is a removable sleeve which may be inserted for use with a three-sixteenth-inch shaft.

New Crosley Two-Tube Receiver

THE New Crosley Model 51 incorporating a tuning element of the Model V receiver, used by Leonard Weeks of Minot, N. D., in his consistent handling of traffic with MacMillan's expedition at the North Pole, has met with instantaneous success since it was first placed in the hands of distributors by The Crosley Radio Corporation. This new set sells for $18.50 and consists of a detector using the genuine Armstrong regenerative tuning and detector circuit, with the addition of one stage of audio-frequency amplification. This makes it possible to use a loud speaker upon local stations or with stations that have exceptionally high power transmitters. One Multistat takes care of both filament voltages in the two tubes used. Provision is made for a "C" battery and a grid leak if the owner desires to use them. A two-step audio frequency amplifier may be used in connection with this set.



Reports have already been received from owners of this new set, one man having received 68 stations, including some on a loud speaker. This little set is built in a handsome mahogany cabinet and makes an ideal receiver for placing in the living room or any other part of the home. Its operation is so simple that children can use it with ease and any type of vacuum tube may be used with good results.

F-F Battery Charger

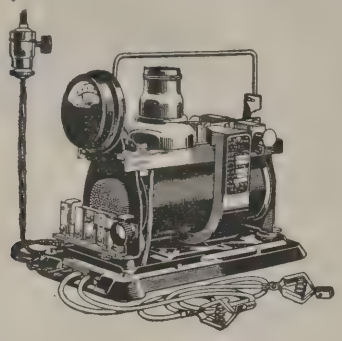
INCREASING interest has been displayed lately in the type A. B. F-F charger manufactured by the France Mfg. Co. of Cleveland, Ohio.

This charger incorporates all the features that have made the type 6 charger so popular, and embodies new and exclusive refinements that are of interest to the user of the storage battery.

The type A. B. charger charges 2-4-6-volt radio "A" batteries, 6-volt auto batteries and "B" batteries from 20 to 120 volts; therefore it is rightly called the triple duty charger.

Some distinctive features of the F-F chargers are: Carbon to carbon contactors that cannot burn or stick; a high charging rate that tapers down as the requirements diminish; acts independently of battery, therefore it will charge a dead battery.

The new bulletin of the France Mfg. Co. containing information on battery maintenance, station calls and wiring diagrams for basement installation of batteries is just off



the press and can be had by sending a postal to the above company at 10360 Berea Rd., Cleveland.

Sherman Wire Fittings

Assortment number three of the Sherman Wire Fittings for Radio, manufactured by the H. B. Sherman Mfg. Co., Battle Creek,

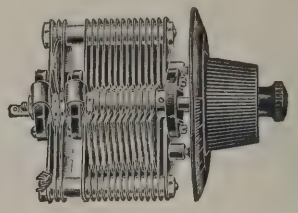
Mich., contains small terminals for use in building radio sets and labor-saving wire fittings for installing them.

It includes genuine Sherman Fixture Connectors, the famous device by which strong, safe connections between wires can be instantly made without soldering.

The workmanship and material of this line are the very best. Articles included are those which wide experience and active participation in radio development have proven practical and popular.

New York Condensers

THE New York Coil Company have developed a line of 23 and 43-plate condensers of both vernier and standard types. Possessed of high electrical qualities, they are of metal frame construction with genu-



ine bakelite insulation. The plates are of heavy hard aluminum with wide spacing and the contact is of the spring type.

They have adjustable cone bearings to take up wear and knobs and dials are furnished with the vernier type.

INDUSTRIAL INKLINGS

THROUGH an agreement just signed between the Radio Corporation of America and the Brunswick-Balke-Collender Company, phonograph manufacturers, millions of radio fans throughout the United States will receive for the first time, operatic and musical programs rendered by famous artists whose services have hitherto not been available to broadcast companies. Under the contract recently concluded, the phonograph company gains the right to install radio receiving sets in combination with Brunswick phonographs. In turn the phonograph company will add its share to the public service now rendered by the principal broadcast stations and aid the development of free broadcasting to the public, by permitting the stations of the Radio Corporation of America and those of its associates to broadcast during the periods when its artists are recording for phonograph reproduction and to encourage artists to aid the program at other times as well. Another interesting provision in the contract places at the disposal of each company, the technical and research facilities as developed by the other, so that the experiences of both industries may be available in the development of the art in the future.

THE Buffalo Forge Company manufacture the Junior Bench Drill. The features which have made it adaptable to radio parts manufacturing is the fact that the spindle can be driven at 3,000 r.p.m., and still remain in perfect balance. The drill has a substantial cast iron frame and a round table mounted on a substantial support. It is regularly supplied with a No. 2-A Jacobs chuck. The construction is of the latest design and may be either pulley or direct motor driven.

THE American Hard Rubber Company, New York City, send out regularly publicity by Brainard Foote, their radio engineer, which is of an excellent character.

CHARLES H. LEHMAN has resigned as President and General Manager of the Dictograph Products Company. Mr. Lehman was the founder of this organization and under his active management the company has developed from a small beginning into an international organization with world-wide distribution. Mr. Lehman has been interested in the radio field since the early days of the industry, and his genius as an executive has been recognized as an important factor in the upbuilding and stabilization of the radio industry. He has also been prominently identified with several other industries and is a director of the Falls Motor Company and of the Kookwik Products Corporation.

Mr. Lehman has not as yet announced his future plans, but it is understood that he is to head a very large radio organization now being incorporated for development and manufacturing purposes.

His successor in the Dictograph Corporation has not yet been selected.

ALDEN MANUFACTURING CO., Springfield, Mass., have devised a unique method of publicity in circular letters to the trade which embody information of a pertinent sort. These letters are so constructed that they can easily be made into an article by editors of publications.

THE Manhattan Electrical Supply Company, Inc., New York City, have a window display on Red Seal Dry Batteries which cleverly portrays their use in radio rather than the article itself as an individual unit.

MR. H. T. GREELEY has been appointed Advertising Manager of the General Radio Company of Cambridge, Mass. Mr. Greeley was a member of the class of 1919, Dartmouth College, and was formerly of the advertising staff of the Winchester Repeating Arms Co. of New Haven, Conn.

The General Radio Company of Cambridge, Mass., have purchased 20,000 feet of land adjacent to their present factory and will start construction at once on a four-story concrete building. This new unit will have the same capacity as their present building, thus doubling their present facilities.

THE Mica Insulator Company, 68 Church St., New York City, has had an election of officers.

Mr. L. W. Kingsley becomes chairman of the Board, Mr. Edward T. Wood, becomes President, Mr. Edward Nelson becomes Secretary and Treasurer.

These gentlemen have for a very long time been identified with the Mica Insulator Company. This company has been one of the pioneer developers of insulation products for almost all electrical application. Many of their products having been employed for thirty years in the electrical industry. Some of their better known trade-mark brands include Micanite, Armatite, Empire, Conducell, etc.

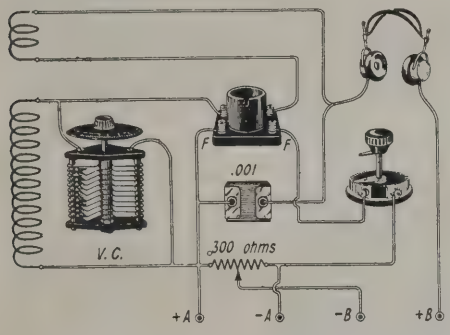
THE Shaw Insulator Company of Newark, New Jersey, report the appointment of Benjamin Phillips as their Cleveland District Sales Manager, with offices in the Stuyvesant Building, 3030 Euclid Ave., Cleveland, Ohio.

CONDUCTED BY R. A. BRADLEY

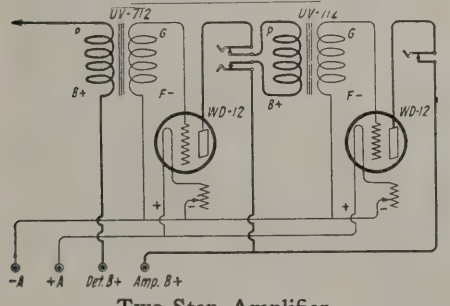
Due to the great volume of correspondence which this department entails we are forced to remind our readers on the following points: Be sure to enclose a self-addressed stamped envelope with your letter. Make your questions clear and concise. If you wish information on your set please enclose a rough sketch or hook-up if possible. Do not ask us to make comparisons between different makes of apparatus or sets.

Detector Tubes

Mr. J. H. Warden of New York City has been having a great deal of trouble with his detector tube, a UV-200. He says, "When I have a station tuned in and then attempt to bring it up in volume by turning up the plate variometer, the tube flops over into oscillation. When I turn the variometer back again, then, the station goes completely out."



Mr. Warden, you have, in the UV-200, the most sensitive detector tube in existence, but also the most critical and hardest to humor. A UV-200 is a good test for a man's self control. It is critical in plate voltage using anywhere between 16½ and 22½ volts. The proper voltage can only be discovered by experimenting. The filament voltage is almost as critical, requiring generally, less than five volts. A vernier rheostat of some description can be used to good advantage in controlling this. Now the way to get the most out of a UV-200 or any "soft" detector tube is to use a good potentiometer across the "A" battery to control the B-battery voltage. This also acts as a sort of vernier adjustment in controlling regeneration and is the secret to DX reception in a regenerative receiver. The circuit in figure 2 shows how this is connected into the set.



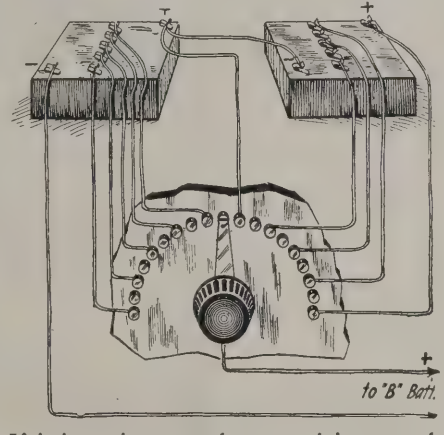
Two-Step Amplifier

Mr. B. H. Law of Reading, Pa., requires a hook-up for 2 UV-712 R.C.A. audio frequency transformers in connection with 2 WD-12's. Below is shown the hook-up for a two-stage amplifier using these instruments.

"B" Battery Control and Shielding

"I want to apply a switch to control my B batteries of which I have two 45-volt units. I would like to use a tapped voltage from 45 to 90. Also I would like to know if I would profit any by shielding the back of each variable condenser dial with a thin sheeting of copper. Should this be grounded to the axis of the condenser?" Signed, A. F. Berkley, Cincinnati, Ohio.

The diagram for using a switch to regulated your B battery voltage is shown below. The purpose of the "dead" contacts between the "live" contacts is to prevent shorting the cells of the battery in case the switch is left touching two adjacent contacts. Answering your second question, if in connecting up your variable condenser in the circuit, you connect the rotor plates to the ground or filament side of the circuit and the stator plates to the high potential or grid side of the circuit you will obviate the need for shielding of any description.



If it is variometers that are giving you the trouble then it will be necessary to shield. In any case do not allow the shielding to come in contact with any metal part of the instrument. Any attempt at shielding the dial of the instrument, itself will be entirely unsatisfactory.

Harkness Reflex Circuit

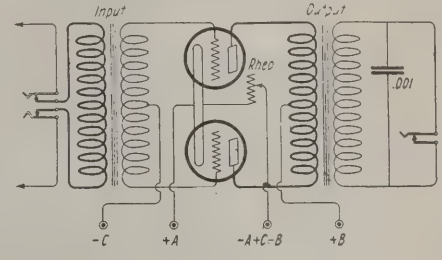
Mr. Harvey G. Rice of Burke, Va., asks for the diagram of the Harkness Reflex Circuit Receiver. The diagram for this set is shown on our page of circuits in this issue.

Three Circuit Regenerative Receiver

Mr. Henry L. Galson writes, "I want to thank you for the answer to my inquiry about my three circuit regenerative receiver. I have no trouble in getting distant stations. KDKA I have every evening and KFKX quite as regularly on my one tube set. This proves the quality of information given out by your magazine, which I am recommending to my friends."

Push-Pull Amplifier

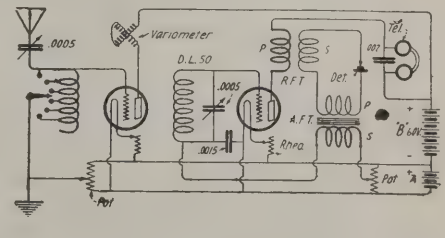
I have read much about "Push-Pull" amplification and I would like to add a step of it to my present two-stage amplifier. But I do not know how to hook it up. Will you please send me a diagram for one stage of push-pull to be added to an ordinary home made set. Thus writes Mr. J. A. Ramsey of New Orleans, La.



The hook-up for this amplifier is shown below. The outstanding features of push-pull amplification are increased volume, clearness of reproduction and elimination of distortion, although distortion already present in the straight audio amplifier will be quite as much in evidence in the push-pull stage. Although all tubes lend themselves well to this type of amplifier the UV-201A and the 216A serve the best. In the February issue of THE WIRELESS AGE there was given a very fine treatise on push-pull amplification, including among other things hints on the use of the ordinary audio frequency transformer in such an amplifier.

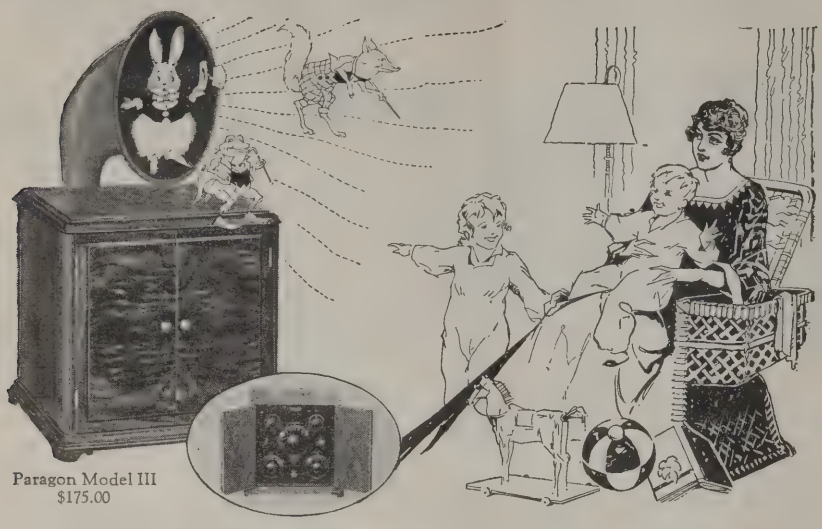
Improved Reflex Set

Below is shown a diagram for connecting up an "Improved Reflex Set" published in



the May, 1923, issue of THE WIRELESS AGE, for which Mr. M. A. Robinson of Washington, D. C., asks. This set can be made up from parts usually found around the experimenter's laboratory or workbench. The antenna tuning inductance consists of fifty turns of No. 24 D.C.C. wire tapped every ten or twelve turns.

(*Continued on page* 86)



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3-CIRCUIT RECEIVER

Amplifiers

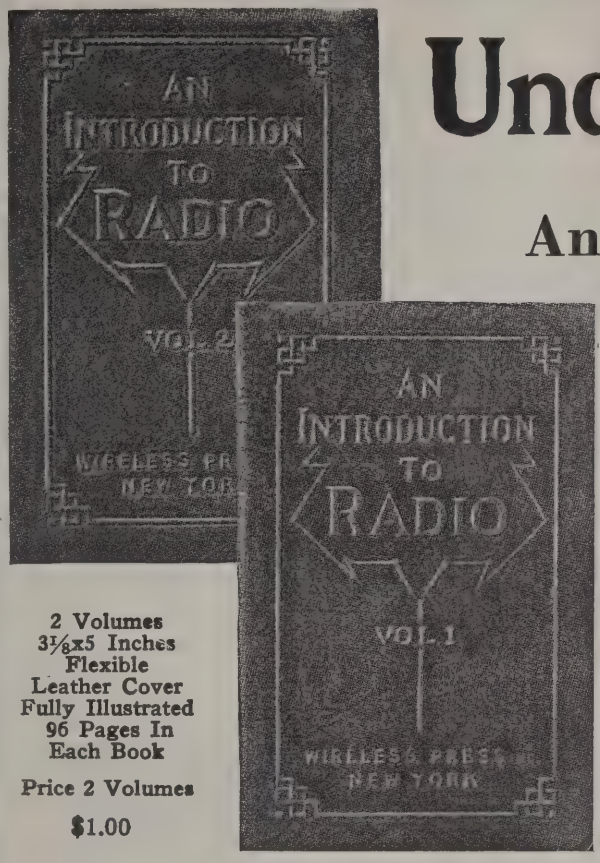
(*Continued from page 37*)

where L is the inductance, C the capacity, and R the resistance of the tuned plate circuit. If a curve is taken of the amplification which this system gives at different frequencies it will have the appearance of figure 6. From this curve it is seen that maximum amplification occurs at the fundamental frequency of the tuned circuit, and that for other frequencies on either side of the fundamental the amplification falls off very rapidly. Consequently such an amplifier differs from those previously discussed in that it is a selective amplifier. The more selective the amplifier is the greater will be the amplification at the particular frequency to which it is tuned, and the less the amplification at other frequencies. Consequently such an amplifier involves to some extent a so-called critical adjustment. This is what makes tuned radio frequency amplifiers so difficult to get working right, as all amateurs know by now.

Let us see what conditions determine the selectivity of the amplifier. The main factor determining the selectivity of the amplifier is the sharpness of tuning of the radio frequency circuit LRC in the plate circuit. As the resistance R of the coil decreases the decrement or damping of the circuit likewise decreases. The condenser tuning will then become finer and more critical, the result being great selectivity with high amplification at the natural frequency of the circuit, and relatively less amplification at other frequencies. But a low coil resistance means that the tuned circuit is a very efficient circuit, since the resistance losses are low. Hence we see that an efficiently tuned circuit will make a highly selective amplifying circuit.

Furthermore from equation (1) which gives the effective resistance of the tuned circuit, we see that the effective resistance is directly proportional to the ratio L/C. The higher the ratio L/C the greater is the effective resistance, and therefore the greater the damping. The greater damping results in broader tuning and therefore gives a less selective amplifier. Thus to maintain a highly selective amplifier the tuned circuit must be built so that the ratio of L/C is low; that is there must be low inductance and high capacity.

If amplification is desired on one wave length or over a very narrow band of wave lengths, this circuit has a great advantage in that other frequencies other than those at which amplification is desired are not amplified very much. For a highly selective tuned circuit amplifier, then, we see that the following conditions must be met. First the resistance of the in-



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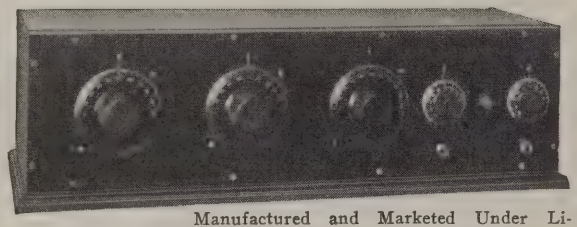

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THE new five-tube "Minute Man" was specially constructed to meet the demand for a receiving set embodying these features:

No Squeals
Tune in either with a loud speaker or head phones without any squeals or rasping. At any setting of the dials there is none of this unpleasantness so prominent in many other sets.

Pure Tone
The reproduction of broadcasting by the "Minute Man" is remarkable for its clarity and sweetness of tone, increasing your enjoyment a hundredfold.

Simplicity
The "Minute Man" is simplicity itself to operate. The dials can be adjusted by a child—and the set is "Fool-proof." The dial settings are constant. A station once located can always be brought in without preliminary searching.

Genuine mahogany cabinet and panels.
Gold engraved dials.

Free Booklet
Booklet "How to Build a 5-Tube Receiver, Using Three Phusiformers," sent free on request. Address Dept. 225.

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For catalogue and prices of Pathé line.

PATHÉ PHONOGRAPH & RADIO CORP.,
20 GRAND AVENUE, BROOKLYN, NEW YORK

ductance coil L must be very low. Second the tuned circuit must be so designed that the ratio L/C is small, that is capacity must be predominant. If on the other hand a relatively non-selective tuned amplifier is desired, that is one which will amplify equally well on a wider band of wave lengths, then the following conditions must be met. First the resistance of the tuning coil should be high. Second the ratio L/C of the tuned circuit should be high, that is the inductance should predominate.

This system in amplifiers possesses very great importance. For while we have thus far considered the tuned circuit to be composed of a lumped inductance and a lumped capacity, it will shortly be seen that this need not necessarily be the case in order to have a tuned circuit. Thus we may have in high frequency amplification an apparent inductance amplifier, but which in reality is a tuned circuit amplifier owing to the distributed capacity acting as the tuning condenser. Thus inductance amplifiers may be very selective due to this reason. This same reasoning applies also to transformer coupled amplifiers.

The Theater in Radio

(*Continued from page* 24)

imagine herself talking into a telephone. Whereupon, she discoursed with seeming eloquence on the subject of Douglas, and was nearly through her compliment when her hand trembled and she quoth, "Dear me, I am terribly nervous." Forthwith, she regained her confidence, as her secret was out and nothing of great consequence came of it.

Then Douglas, none the worse for microphone fright, did speak most gallantly on the subject of Mistress Mary, he becoming so enthusiastic he half arose from his chair and gesticulated in such fine fashion I did regret his pantomine could not be broadcast. Nor was I at an end to my envy, having seen him in person, for I bethought me of the furnishings I had wrecked in my home, so incompetent am I in the matter of leaping about, and I have been at great pains to match his sprightly conduct.

A bank of seven cameras faced them before they had finished broadcasting which did suit their notion of how to finish off in great style, and I was in particular impressed with their patience, of which I have small store, they posing for near fifty minutes. Great numbers of pictures were made and I secretly praying that some plague smite all photographers. Mistress Mary doffed her hat, she acting in accord with a protest that any of her face could register over well and I was struck in especial with the mar-

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its latest achievement in the field of Radio

The "No. 102 Special" Federal Receiving Set will be demonstrated to radio enthusiasts beginning May first.

If you do not know the name of the Federal dealer in your locality, write immediately to

FEDERAL TELEPHONE AND TELEGRAPH CO.
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Federal Standard RADIO Products

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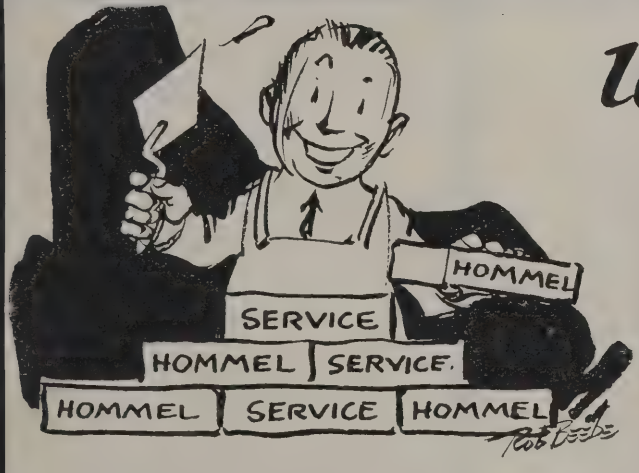

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Patent Pending

Here It Is!! *for Your Receiving Set*

A truly beautiful piece of living room furniture

HAVEN'T you long wanted something really decorative and thoroughly practical to accommodate your receiving set? Then consider the new RADIO-SPINET.

It places the receiving set in exactly the right position for comfortable operation—just as though you were writing at a desk. Back of the receiving set, and completely concealed from view, is a large, roomy, accessible compartment for all batteries (both wet and dry), charger and wires. Ample space is provided on top for any portable loud speaker. At each end of the cabinet is a convenient, roomy drawer. The RADIO-SPINET perfectly accommodates most popular types of radio instruments, and is furnished in your choice of various beautiful mahogany finishes.

Summed up, the RADIO-SPINET answers all of your cabinet requirements;—it is the final step to the completion of your radio assembly.

Radio Spinet
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vel of her hair which was a golden corn yellow in color, and I bethought me what a pity it was that films prove so inadequate in the matter of portraying such beauty. Whereupon I was at pains to converse with Mistress Mary and Douglas on the limits of the cinema, but he put me at score straights on the problem of broadcasting even the approximate results achieved in the silent drama. Nor had I recourse to aught than speculation on the possibilities in the public prints which I deemed could furnish pictures of the cast and such scenes as would illustrate what play was broadcast. To which he acquiesced lustily enough, pointing out that such methods were sufficient for radio plays, but did flout me on the score that musical comedies are of a character which the public prints and radio do enhance, and I was reminded of my inclination to go straightway for tickets after I had listened in on those that were transmitted from the stage. And he did convince me finally.

Mistress Mary, attentive betimes, bespoke me seriously for being such a dullard, she telling me that her radio discourse on "The Thief of Bagdad," which Douglas was at some length to produce, would so arouse curiosity that the Liberty Theater would scarce hold the crowds. And Douglas quoth that he likewise had told the radio audience of such episodes that were of interest concerning Mary's new picture, "Dorothy Vernon of Haddon Hall," and he deemed the seating capacity of the Criterion Theater would be, forsooth, scant enough.

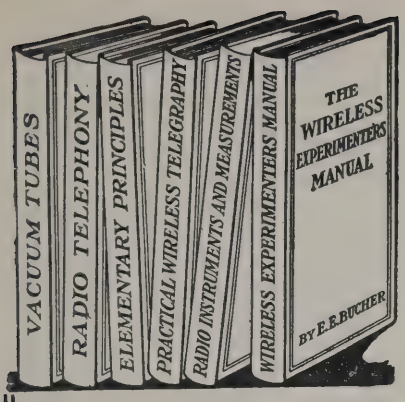
I did learn that neither had been unduly liberal in their estimate of radio for I had great difficulty to purchase even standing room, but I was not at any great pains to endure no seat at all as I found both shows to my liking, the more for having learned of things that did not appear on the screen.

* * *

After some reflection, I did decide that radio provides me with more pleasure than ever I thought was possible in this day of costly entertainments. The theater in radio means that I may twirl the dials of my receiver in quest of a good show and trust to none other than my own best judgment. Dramatic criticisms and the council of my friends have cost me dearly, for no one, save myself, can know what show I like best. And I have likewise been a victim to great inconvenience because of my suburban residence.

In truth, the twirling of the dials on my radio will now be a pastime in which I may overindulge with impunity.

The theater has, indeed, come to radio for its broadcast blessing. And I do believe I am, myself, blessed for that.



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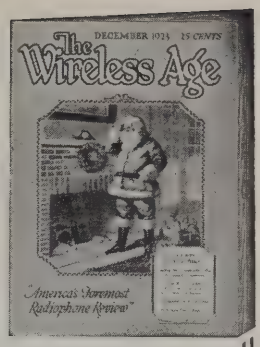

Pick out the books you want and Buy at these Rock Bottom Prices

Here is the greatest list of radio books ever presented. In this list are books that are known and used the world over.

Our stock room is overcrowded—we must reduce the weight per square foot. This gives you the chance to buy these books at a tremendous saving. Take advantage of this opportunity to complete your radio library.

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Vacuum Tubes	E. E. Bucher	2.25	35
Wireless Experimenter's Manual	E. E. Bucher	2.25	35
How to Pass U. S. Government Wireless Exams.	E. E. Bucher	.75	10
How to Conduct a Radio Club	E. E. Bucher	.75	10
Alexanderson System	E. E. Bucher	1.25	18
Practical Amateur Stations	J. A. White	.75	10
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Prepared Radio Measurements	Batcher	2.00	30
Modern Radio Operation	J. O. Smith	1.75	26
Radio Inst. and Measurements	Bureau of Standards	1.75	26
The Oscillation Valve	Bangay	2.75	40
Elementary Principles of Wireless—Part 1	Bangay	1.75	25
Standard Tables and Equations	Hoyle	3.25	50
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Technical Instruction for Wireless Telegraphists	Hawkshead and Dowsett	3.50	55
Elgie's Weather Book	Elgie	2.00	20

BOOK	AUTHOR	Regular Price	Class No.
Alternating Current Work	Shore	$2.00	25
Magnetism for Home Study	Penrose	2.25	30
Radio Directory and Call Book		1.00	12
1923 Year Book of Wireless Tel. & Tel. (Cloth)		6.00	80
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Clarity

Radio is most enjoyable when the programs of music and other forms of entertainment are coming in sweet and clear; loud enough to be heard perfectly on the loud speaker, yet faithfully reproducing the voice of the singer or the harmonies of the instruments.

Clarity of tone is a feature that has made hosts of friends for the FADA "One Sixty" radio receiver. No matter where the station tuned in may be located—in the East, or in the West, the clarity of tone produced by the "One Sixty" is remarkably lifelike and pure. And so powerful is this wonderful receiver that the majority of broadcasting stations, both local and distant, can be heard clearly and plainly on a loud speaker.

Quality—in design and workmanship—characterizes the FADA "One Sixty" through and through. Combining as it does the famous Neutrodyne principle with skilled FADA craftsmanship, the "One Sixty" represents a great feat of radio engineering.

In selectivity, volume, distance getting, clarity and fine appearance, the FADA "One Sixty" is unsurpassed. To hear it perform is to be convinced. It will be well worth your while to visit your dealer and see this receiver. Price $120. This does not include tubes, batteries or phones.

F. A. D. ANDREA, INC.

1581 Jerome Avenue New York City

FADA Radio

F.A.D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC. NEUTRODYNE UNDER HAZELTINE PATENT NO 1450080 DATED MARCH 27 1923 OTHER PATENTS PENDING TRADE MARK REG. U.S. PAT. OFF.

Short-Wave Receiver

(*Continued from page* 59)

the entire range excepting at about 145 meters where careful adjustment is necessary. The tube oscillates very readily at 100 meters.

Now in order to change this receiver so that it will cover the broadcasting wavelength range it is only necessary to add a few turns of wire on the two coils. The antenna circuit (L_1) instead of having 3 turns should have 6 turns of wire. The secondary coil (L_2) is a continuation of L_1 and should be wound with 40 turns instead of 15. The tickler coil should have about 20 turns and if the whole receiver is made with great care and according to these instructions even less turns may be used.

[A set embodying these changes was built in our laboratories and has been used with great success in receiving distant broadcasting stations, proving unquestionably superior to another set of reliable manufacture which embodied three stages of radio frequency amplification. — EDITOR'S NOTE.]

Afloat and Ashore With the Operators

(*Continued from page* 49)

and will be remembered as one of the heroes of the *Monroe* disaster in 1913, in which his partner, Frederick J. Kuehn, lost his life after giving his life belt to a woman passenger. Etheridge is now on the Standard Oil tank steamer *Baton Rouge*.

Harold Hatton, now on the steamer *I. C. White,* was a well known ship operator running out of New York twelve years ago.

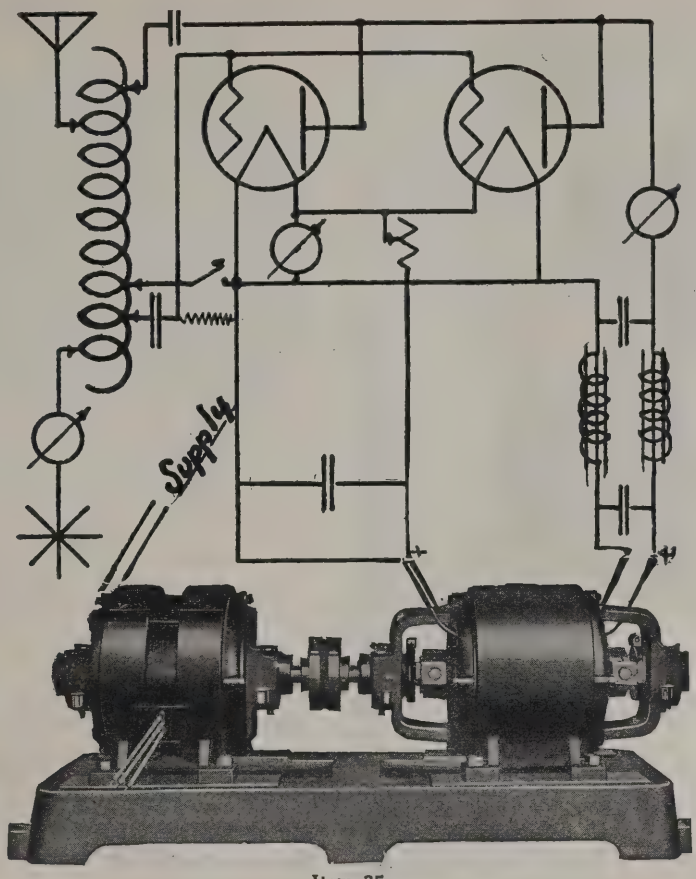
Eugene O. Lemieux, now on the Canadian steamer *Ormes,* but running between New York and the West Indies, received his first assignment on an American ship in September, 1907.

Emanuel J. Marschall was assigned to a passenger ship twelve years ago. He is now senior on the Red D Liner *Maracaibo*.

Frederick W. Harper, operator on the *Hahira,* has been a radio man since April, 1912.

M. B. G. Rabbitts has traveled to all points of the globe during his thirteen years' continuous radio service and is now on the tanker *Standard*.

E. W. Rogers started as a radio operator in June, 1909, and has had many experiences during the past fifteen years, the most peculiar of which was when he read his own death notice in the newspapers following his return from a voyage to South Africa on a



Item 35

A FEW GOOD COMBINATIONS.

Item		Description				Recommended for		
2	350 V	40	Watt			2-5	watt	separate Fil. supply.
7	500 V	100	"			4-5	"	with separate Fil. supply.
8	500 V	150	"			5-5	"	2 mod. 1 mast. osc.-2 osc. sep. Fil. supply.
13	1000 V	300	"	dbl.	comm.	2-50	"	with separate Fil. supply.
15	1000 V	500	"	"	"	3-50	"	or 2-50 watt and 4-5 watt as speech amplifier and mast. osc. Sep. Fil. supply.
16	1000 V	650	"	"	"	4-50	"	with separate Fil. supply.
20	1500 V	600	"	"	"	2 to 3-50	"	with separate Fil. supply.
24	2000 V	500	"	"	"	1-250	"	with separate Fil. supply.
26	2000 V	1000	"	"	"	2-250	"	with separate Fil. supply.
31	500 V	100	"	10 V	60	Watt same as item	7	but with Fil. supply.
35	1000 V	300	"	12 V	150	" " "	"	13 " " " "
41	2000 V	500	"	14 V	200	" " "	"	24 " " " "

Many other sets for various combinations of tubes. Special sets made to order.

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Write for Bulletins 237B and 242A Listing over 200 combinations.

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Send us your problems—we'll help you solve them.

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7 POINTS OF BEL-CANTO SUPERIORITY

1. Our own Fiber horn. Crystalline finish.
2. Our own adjustable loud speaking unit, giving a wide range of tone quality and volume without distortion.
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5. Complete instrument stands 22½ inches high, 10-inch bell.
6. Guaranteed for one year from date of purchase against mechanical defects of any kind.
7. No auxiliary batteries required. Just plug in on second stage.

GUARANTEE

Money back any time within ten days if dissatisfied. We further guarantee to the publication carrying this advertisement that each and every speaker will be sold on the above terms and the instrument will be exactly as offered in this issue.

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BEL-CANTO MFG. CO.,
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Gentlemen:

Please send me on ten days trial 1 BEL-CANTO as advertised. I agree to pay postman $10.00.

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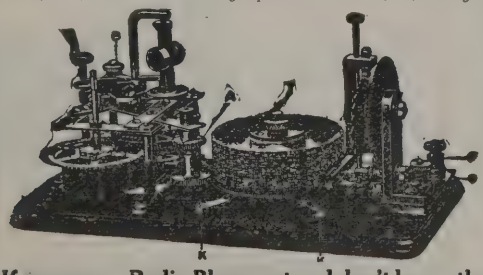
Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"



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"Look at That Workmanship!"

A striking feature of the new Eisemann Receiver is the unusual interior construction.

No confusing array of criss-cross wires—just a group of fine instruments so arranged and co-ordinated as to give the utmost electrical efficiency.

The wiring—and there is little of it—is invisible. All leads are short and direct, thus eliminating causes of interference and improving the quality of reception.

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Showing Contacts

Jones Multi-Plug and Cable

The Standard Radio Set Connector

Either panel or binding post mounting.
Does away with unsightly wires.
Leaves set free from live wires when not in use.
Several binding post ends can be connected to different sets—using one plug and cable connected to batteries, etc.
Ideal for dealers—and experimenters.
Prices, Multi-Plug and Cable Panel Mounting Type, $4.00. Binding Post type, complete, $5.00.
Write for illustrated folder of Howard B. Jones Radio Products

Howard B. Jones, 612 S. Canal St., Chicago, Ill.

sailing vessel during the war. He left New York at the time the German submarines were along the American coast and in a storm the first day out his wireless equipment was demolished, and a life boat was lost. The finding of the life boat and the fact of no word being received from the vessel seemed to furnish proof that she had been torpedoed and sunk with all hands. Rogers is a big man physically, has a big deep voice, a big heart and a big knowledge of radio operating. He is well thought of by his co-workers. He is now on the *Winona.*

Charles L. Fagan, who has been senior operator on the Grace Liner *Santa Elisa* for the past two years with no thought of a change, is rounding out his twelfth year as an exclusive passenger ship operator, this record being broken only by about six months spent as a railroad operator in 1918, but on leave of absence from his employers.

Charles E. Stevens on the *Santa Cecilia* has seen more than a decade of years go by while serving as a ship wireless operator; George Kavanagh, senior on the *City of Birmingham,* about as many, and C. S. Thevenet, senior on the *City of Chattanooga,* about twelve, the most of which has been on the Savannah Line, with the exception of his service as a naval radio operator during the war.

Carl L. Jones is another old-timer and has run on ships under six different flags in the past nine years. He is now on the tanker *Joseph Seep.*

These men represent the pioneers of the Atlantic coast who are still radio operators aboard ships in active duty. It is to be regretted that the presentation could not be completed by photographs of all. If there is a pioneer whose name should have been mentioned and is not, we would be glad to hear of him.

One Tube Reflex

(*Continued from page* 55)

the amplifier tube was useful as a socket for the R.F. transformer, and only my grid leak and one rheostat were left over. It worked 100 per cent. as soon as the last connection was made.

On local stuff it gave volume enough for one room; its distance range was approximately the same as for the ultra-audion; it was practically as easy to tune as the ultra-audion—especially when using the WD-11 tube; but the quality of reproduction, particularly on distant stations, was far superior to that of any regenerative set.

Further experimentation has led to standardizing the single-tube reflex

MAHOGANITE Dials that match the set

Like all other distinctive products, Mahoganite has its imitators. But these imitations are on the surface only. Mahoganite is not a surface finish. The electrical values of Mahoganite extend through the material.

The only way to assure yourself of genuine Mahoganite Panels, or Dials which match the panels, is to make sure that the RADION Trademark is on every one that you buy.

21 Stock Sizes

Mahoganite and Black

6x 7	7x14	8x26
6x10½	7x18	9x14
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7x10	7x30	14x18
7x12	7x48	20x24

RADION

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PANELS

Dials, Sockets, Knobs, Insulators

Look for this stamp on every genuine RADION PANEL. Beware of substitutes and imitations.

At all good Radio shops or write to

American Hard Rubber Co.

11 Mercer Street New York

As You Gaze at the Stars—
The gentle calm of a bright starry night fills us with mystery. Little did we dream a while back that today, far and wide in the unknown, thousands of voices, hurled by electrical energy, are rushing at unheard of speed through space to all points of the compass.
A person here, a group there—in fact, in a million or more homes people are anxiously tuning in on their radio's groping in the air, hoping to catch the sound of a far away station. Scarcely a sound, a slight turn, a faint noise, another adjustment and then clear and clearer comes voices, a quartet is singing; so clear and distinct come the soft gentle melody that the listeners close their eyes, the singers seem to be in the very room with them.
If you desire clearer reception, greater volume and the elimination of howling and distortions, install Jefferson transformers in your set.
There's a Jefferson Transformer for every circuit.
Write for amplification data and interesting descriptive literature.
JEFFERSON ELECTRIC MFG. CO.
431 So. Green St., Chicago, Ill.
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Last year was a $175,000,000 radio year, and Radio has just commenced to grow! Get in on the ground floor. Train for a position as Radio Operator or Radio Installation and Service man. New Radio Sales and Service course. Radio Operators' course by correspondence.

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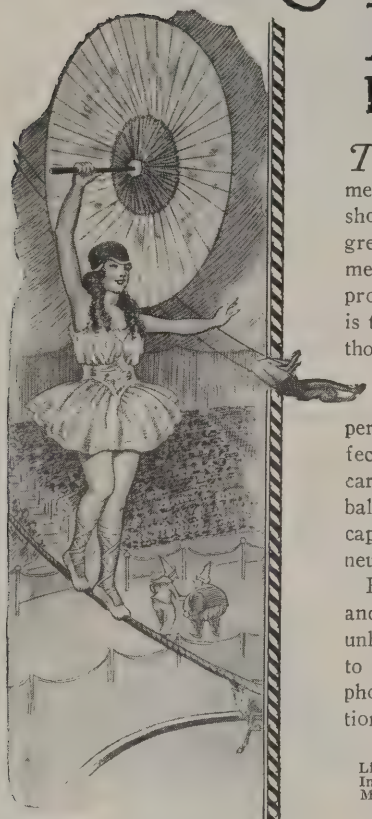

Perfect Balance Secret of **Eagle** *Supremacy*

The SHEER WEIGHT of overwhelming merit has given to the name, "EAGLE", in a short time a tremendous significance—the greatest of neutrodyne receivers. Hearsay, mere "claims" or boasting could not have produced such sensational prominence. This is the verdict of radio engineers, leading authorities and of radio fans who have made an absolutely unbiased comparison.

The secret of the EAGLE'S marked superiority is its infinitely fine balance—as perfect, as flexible, as dependable as that of the carefully trained tight-rope walker to whom balance means life, itself. Balanced tube capacities is the fundamental principle of the neutrodyne receiver.

Each EAGLE NEUTRODYNE RECEIVER is balanced by a neutrodyne expert with the same unhurried, painstaking precision as devoted to the first EAGLE. As easily operated as a phonograph. Guaranteed without reservation.

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of the
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Over 200,000 small town circulation of the highest type

shown in figure 2 as the most satisfactory type.

In place of the wooden variometer shown there may be used instead, a tapped tube-wound coil, a fixed coil, a honey-comb coil or an Estru variometer, but the results will be not quite as good. The All-American audio transformer and Acme A-2 transformer have been found to give about equally good results. The All-American radio transformer and the Acme R-2 have been tried, and function about equally well. Several types of potentiometers have been tried and .001 fixed condensers have been used instead of the .002 and .0025 shown. Perhaps it is a matter of personal preference, but I use All-American audio and radio transformers, a Fada 400-ohm potentiometer and any good variometer, while the fixed condensers are usually Micadons of the value indicated. The thing which makes this circuit unusual is the fact that almost any sort of apparatus may be used with good results and none of the values are critical.

TUNING THE SET

In tuning, I usually set the variable condenser with the plates one-quarter to one-third in, then leave it alone, except as the vernier blade is used for very fine adjustment. Practically all tuning is done on the variometer and if the condenser is left alone in a certain setting the variometer dial may be calibrated very closely to wave length readings, or a station may be identified by the variometer reading.

The potentiometer is most useful on distance work. Thus it will be found that one extreme position gives maximum oscillation and volume and the other extreme position gives minimum oscillation and volume. For the long wave lengths the potentiometer is set for greater oscillation, and this is also true for stations of less than 360 meters. As the wave length decreases from 500 meters to 360 meters the potentiometer must be moved toward the "low" end, as otherwise the excessive oscillations will produce howling and whistling. On local stuff the potentiometer is not very critical, but on distance it is very important. When using a WD-11 or WD-12 tube the potentiometer may almost be disregarded.

The type of crystal is not very important, and a fixed crystal—Grewol, Erla or "B" metal—is usually used. I prefer the Grewol. Any sort of crystal may however be used, for all you need is some species of rectification.

A 2-TUBE SET WILL GIVE LOUD-SPEAKER VOLUME

Then if you want real volume on this set, just hook on one stage of amplification. Local stuff will come in

Designed to Meet a Popular Demand

A NEW 5 Tube

MU-RAD RECEIVER

MA-18

Selective — Sensitive
Non-Radiating — Single Control

COAST to coast reception under proper conditions. Loud speaker reception on a thousand mile range, all wave lengths. Completely cuts out the strongest local stations. Surprisingly simple control—just one dial, the settings of which are ALWAYS the same for each station. Requires only a single wire antenna. Uses either dry cell or storage battery tubes. Tubes and batteries last twice as long as in other 5 tube receivers because tubes burn at low temperatures.

SPECIFICATIONS

Circuit—2 stages of R. F. Amplification, detector and 2 stages A. F. amplification—an entirely new circuit.

Antenna—Single wire—20 feet to 150 feet long.

Cabinet—Hand rubbed solid mahogany with rubber feet, 12¾ inches by 7½ inches by 15 inches deep. Engraved Formica Panel.

Wave Length Range—230 to 550 meters—practically the entire broadcasting spectrum.

PRICE (without accessories) **$110**

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Reg. U. S. Pat. Off.

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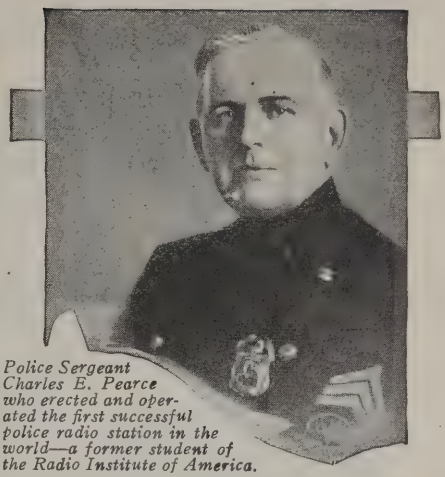

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Using Grimes Inverse Duplex System

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The set for those who want results with little effort. Anyone in the family can quickly learn to operate it because technicalities and guesswork are eliminated—One Control Dial does it all.

Does Not Interfere with Your Neighbor

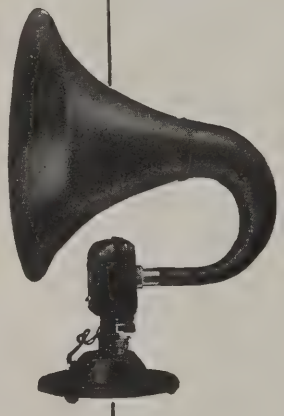
Other close by reception is not disturbed when you tune in with this non-reradiating Receiving Set. It gives you a comfortable sensation of freedom to be able to change from one station to another knowing that you will not interfere with your neighbor's receiving.

Choice of Aerial or Loop

Where conditions make it difficult to install an outside aerial, as in congested sections of cities, good results can usually be had by using inside Loop. In fact, the directional feature of the Loop often brings in stations not possible with a stationary aerial.

Mounted in solid mahogany case with walnut finish, the Bristol Single Control Radio Receiver is handsome in appearance. The price is $190.00. Bulletin 3013-V describing this set will be mailed on request.

—BRISTOL—



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REG. U. S. PAT. OFFICE

Loud Speaker

This is known everywhere as the Loud Speaker with the quality tone. Not only is the tone natural and without mechanical distortion, but is sufficiently big in volume to be easily heard in a large room or all through the house. Comes to you ready to use—no auxiliary batteries are required.

Made in three models:

Audiophone Senior .....Price $30.00

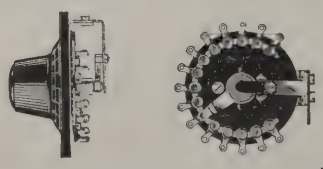
Audiophone Junior .....Price 22.50

Baby Audiophone .....Price 12.50

THE BRISTOL COMPANY, Waterbury, Conn.

CARTER Inductance Switch

15 Points



Rear view showing how each solder terminal and contact are made in one piece.

Mounts back of panel. All connections out of sight. Only one hole to drill. Heavy phosphor-bronze contact arm and pig tail insure positive contact. Special numbered dial knob. Send for Catalog.

$2.

Carter Radio Co.
1802 REPUBLIC BUILDING
CHICAGO

loud enough to fill the house and distance will usually loud-speak sufficiently to fill a room. Also the amplified signals will be remarkably clear and undistorted, especially if you place a .0005 fixed condenser across the secondary of the amplifying transformer. Without this you may experience a thin, shrill whistle. Common "A" and "B" batteries may be used, but I prefer separate "B" batteries, placing from 125 to 150 volts on the amplifier plate, either with or without a "C" battery. Of course, use a 201-A tube in the amplifier as well as in the set, for best and loudest results.

If you add the amplifier unit you now have a 2-tube set, and you can plug into either the first or second tube, just as with a regenerative circuit. For headphone work you will seldom plug into the second tube, because on local reception it would buckle the phone diaphragms and also your ear drums. For distance work on head phones you may occasionally use the second tube. Primarily however the second tube is for loud speaking.

Now you will want to know what you can expect from this circuit. I am using a single wire aerial about 40 feet high, 75 feet long, with about 35 feet of lead-in. The map shows the stations received during the first nine days of November, on the single tube, on headphones. Of these stations I have tested only a few for loud speaking on the second tube. However, very good volume in one room was obtained on the following:

KDKA—Pittsburgh	WOAW—Omaha
WLW —Cincinnati	WDAF —Kansas City
WGR —Buffalo	WHB —Kansas City
WOS —Jefferson City, Mo.	WFAA —Dallas
	KFKB —Kansas
KSD —St. Louis	

It is my belief that the set will loud-speak on the second tube any station it gets clearly on the first tube. Thus KHJ, Los Angeles, was audible three feet from the phones, on the first tube, while WDAF, WHB, KDKA and WFAA are often audible all over the room on the first tube.

By way of experiment a bed has been used as an aerial, bringing in practically the same stations as on the outside aerial, but with less volume. This is in a first-floor apartment. On ten or fifteen feet of wire as an aerial, all of the local stations will loud-speak on the second tube, and several outside stations were received clearly. The set has received Cincinnati without ground or aerial; operates beautifully on distance without any ground; will always bring in ten to fifteen outside stations in the course of an evening while there are from one to three local stations on; and on a silent night captured just 30 outside stations, one being KFEL—Denver—and one being KFI—Los Angeles.

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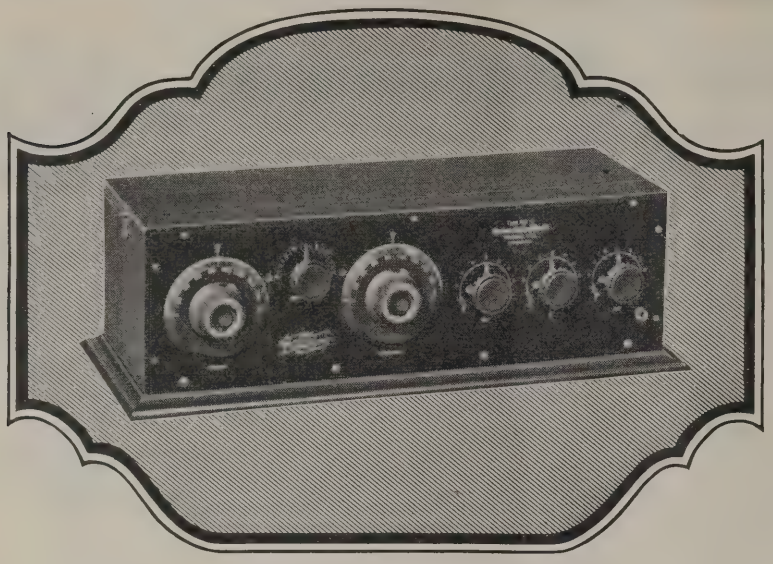
COAST-TO-COAST RECEPTION—and Beyond



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"The Voice of the Nation"

NO LOOPS

With the RADIODYNE you can select broadcast programs from all parts of the country. Honolulu and London have often been picked up by operators in the central states without interference from nearby stations.

The Radiodyne is ready for operation by simply grounding to a water pipe or radiator, and throwing a few feet of wire on the floor. Uses any standard tubes—dry cell or storage battery. Extremely selective. Simple to operate—*Only two controls*—you can tune in on any program you wish—any wave length from 200 to 700 meters.

NO AERIAL

For use in apartments, boats, automobiles, railroad trains, etc., the RADIODYNE is enjoyable where other receiving sets would not be practical.

Price $150.00

Write for illustrated folder which describes the RADIODYNE in detail. Every radio fan will be interested in this new type (antennaless) receiving set.

WESTERN COIL & ELECTRICAL CO.

316 5th Street **Racine, Wisconsin**

EQUIP YOUR SET WITH

AND NOTE THE DIFFERENCE

The H. H. Eby Mfg. Co., Phila., Pa.

BURGESS
RADIO BATTERIES

"A Laboratory Product"

Madison, Wisconsin

I almost forgot to say that in spite of its single-circuit tuning it is fairly selective, especially so when operating without a ground; that it picks up practically no static, operating very nicely during a rainstorm; and that it will not re-radiate, even to another set a few inches away. Now what more could a person demand from a radio set? Nothing, probably; yet because a radio nut is always nutty, I'm experimenting with the addition of one tube of straight radio frequency. If it works I suppose I'll receive London or Honolulu!

Your Future as a Radio Engineer

(*Continued from page 57*)

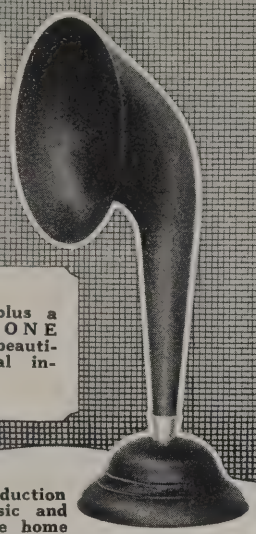
with it you can expect big things of yourself.

When you are turning over in your mind the question of college training you may feel that you'd like to take a short cut, to save all or part of those six years by going to work at once in the laboratory of one of the radio companies. To be sure, that has been done, although men who are listed among the few successful engineers, whether in radio or other branches, are almost without exception college graduates. And if you ask the man who has won through entirely on his own, he will tell you that his was the long road, not the short one. That doesn't mean, either, that the degree makes the engineer, for men of the same age, with or without university training, can start on equal footing. It is in the ability to handle unusual problems, special jobs, that both the technical as well as the social background of college shows up. Not so long ago an exceptionally promising self-trained engineer was invited to the home of an executive who intended to discuss with him the possibility of taking charge of important work abroad, an undertaking which involved contact with various government officials. But the work wasn't even mentioned after all. Why? Because he ate with his knife and drank his coffee with his spoon in the cup! That is not a story to illustrate a point. It actually happened in New York City.

Take a few moments to look over the careers of the radio engineers whose names come quickly to your mind. You know of Ernest Alexanderson because he is Chief Consulting Engineer for the Radio Corporation of America, and because he invented the Alexanderson alternator, employed in all the trans-oceanic radio stations. He is a graduate of the University of Lund and the Royal Institute of Technology, Sweden, after which he took a post-graduate course in Berlin.

Dr. Pupin has written a fascinating story, "From Immigrant to Inventor,"

$8.00



A phone plus a FIBERTONE makes a beautiful musical instrument.

The reproduction of radio music and speech in the home through the Fibertone, is an example of the true tonal quality given by a horn of fiber. One phone from any good head set, when coupled with the Fibertone, renders the broadcast program with wonderful clearness, free from metallic noises. The attractive outward appearance of the Fibertone is significant of the inward beauty that permits such supremity of reproduction. If your dealer cannot supply you, write direct.

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RADIO HORN

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FIL-KO-STAT
THE SCIENTIFICALLY CORRECT RADIO RHEOSTAT

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Millions of radio fans think they are getting 100% results from their sets. We know they are not. We want them to try Fil-ko-stat and learn what perfect reception means; how ability to "tune your tube" gets DX Stations you never heard before—makes tubes function noiselessly, and controls regeneration preventing squeals!

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Price $2 AT YOUR DEALER
IN CANADA 2.75

FOR ALL TUBES

Save!
Trouble and Money
By equipping your radio with the
BRACH COMPLETE RADIO ANTENNA SET
with famous Brach Arrester—every part of highest grade—approved by experienced engineers and National Board of Fire Underwriters. You save time and money and cut out all doubt.
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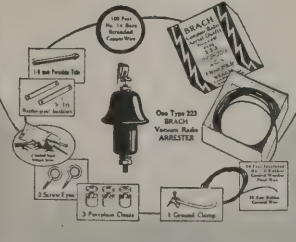

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The best text book on the market devoted solely to the various applications of the Oscillation Valve
Price, see page 73
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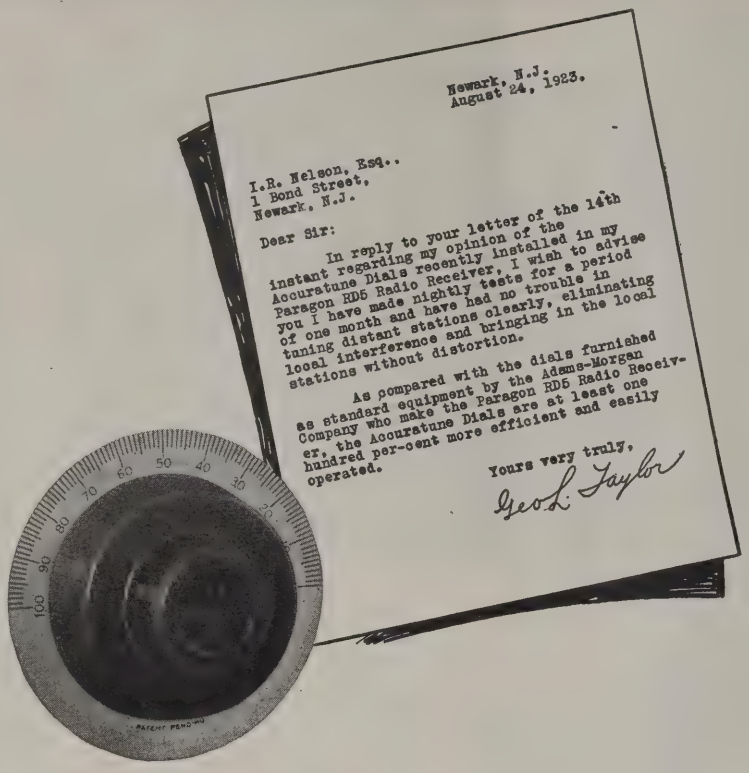
Newark, N.J.
August 24, 1923.
I.R. Nelson, Esq..
1 Bond Street,
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Dear Sir:
In reply to your letter of the 14th instant regarding my opinion of the Accuratune Dials recently installed in my Paragon RD5 Radio Receiver, I wish to advise you I have made nightly tests for a period of one month and have had no trouble in tuning distant stations clearly, eliminating local interference and bringing in the local stations without distortion.
As compared with the dials furnished as standard equipment by the Adams-Morgan Company who make the Paragon RD5 Radio Receiver, the Accuratune Dials are at least one hundred per-cent more efficient and easily operated.
Yours very truly,
Geo. L. Taylor

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Mr. Taylor says, "I have no trouble tuning distant stations! Accuratune dials are at least one hundred per cent. efficient."

It is no little stunt to bring in a distant station, with all local and other disturbances in the air. But with an Accuratune fine adjustments are easy and the slightest turn of the micrometer knob will throw interferences out of the way and bring in the station you want CLEARLY.

The Accuratune is not a mere dial but an actual Micrometer Control more efficient than vernier condensers or any tuning device and far more simple to operate.

Designed for both coarse and precise tuning. Fits all standard condenser shafts.

This unusual tuning efficiency amply repays you for the slight additional cost over ordinary dials. Price, $3.50.

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Phonograph Attachment
Attaches instantly to the reproducing arm and converts your phonograph into a loud speaker. Permits the whole family to enjoy broadcast music.
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Circulars free. This set received the Chicago American regional prize of $350.

TRESCO
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of his career, the kind of a book which is a real inspiration to every young chap who is looking to the experiences of others as a guide for his own plans. Not only did Dr. Pupin graduate from Columbia University, but he studied at Cambridge and Berlin. He has devoted his life to educational work—he is Director of the Research Laboratory at Columbia—but his inventions and consulting practice have brought him far greater monetary returns than his salary as a professor.

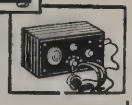
Somewhat similar has been the work of Dr. Pickard. He was educated at Lawrence Scientific School, Harvard, and Massachusetts Institute of Technology. When he was twenty-two years old he took up radio research work under a grant from the Smithsonian Institute. For a number of years he has been associated with the Wireless Specialty Company, although he has a considerable practice as a consulting engineer and patent expert.

No story of radio development could be told without giving John V. L. Hogan a place in every chapter, particularly at the present time, when we are learning the full significance of the heterodyne in radio reception. A graduate of Scientific School of Yale University, where he specialized on mathematics and physics, he has served both as a research worker and a practical engineer with Dr. de Forest in the development of the audion, and the radio telephone, with Fessenden at Brant Rock, on alternators and heterodyne reception, as manager of the International Radio Company, and now as consulting engineer to Westinghouse and as a patent expert.

Dr. de Forest, whose record needs no reciting here, did his first work on the audion while he was acting as instructor after he had completed his college courses. He gave up that work to form the original de Forest Wireless Telegraph Company. Major Armstrong, on the other hand, is still a professor at Columbia, from which college he was graduated, for he has licensed manufacturers to use his inventions, instead of undertaking to operate his own company, as Dr. de Forest did. Major Armstrong, by the way, is the youngest of the first rank radio engineers. I hope he will not object to the disclosure of his birthday date, which was December 18th, 1890.

The careers of Dr. Goldsmith, Dr. Fessenden, John Hays Hammond, Jr., Dr. Kolster, Alexander Reoch, Major-General Squier, and Dr. Kennelly are all built upon years of university work, training that has provided them with great stores of scientific understanding. No, you can't argue yourself away from college without proving that you will be satisfied to accomplish less than these men have done.

Perfect Panels



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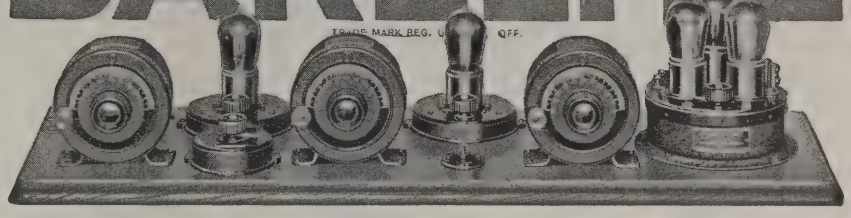

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The enthusiastic commendation accorded Atwater-Kent Radio Broadcast Receivers is due, not alone to the fine workmanship which they exemplify, but to their performance in the hands of inexperienced operators.

The simplified design, made possible through the use of molded Bakelite, is largely responsible for the ease of operation.

Bakelite possesses a combination of properties not found in any other material and which makes it peculiarly suited for this service. Its excellent electric properties provide complete insulation which remains unimpaired under all atmospheric or climatic conditions.

Its great mechanical strength, permanent beauty of finish and color enhance the value of any Radio Equipment in which it is used.

The permanence of *all* the properties of Bakelite have caused leading Radio Manufacturers to adopt "The Material of a Thousand Uses" as standard insulation for the manufacture of parts and complete units.

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Enclose 10c. and let us send you the Bakelite radio map. It lists the call letters, wave length and location of every broadcasting station in the world. Address Map Department.

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provide the ideal instruction

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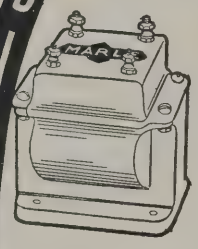
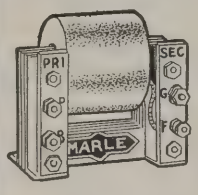
TRANSFORMERS

"The Heart of a Good Receiver"

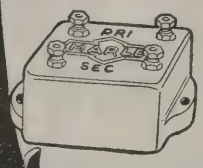
Type A9
Ratio 5 to 1
Shelltype $6.00



Audio F Coretype
Type A7
Ratio of 3¾ to 1
$4.50



Audio F Coretype
Type A6
Ratio 5 to 1 $4.25



Radio F Coretype
Types R1 and R2
$4.00

GUARDIANS of perfect amplification! Equal to the sternest requirements. Repeated tests prove that Marle Transformers amplify *uniformly* over the widest practical range of frequencies. No *Marle Transformers* ever known to howl or produce the slightest distortion. Sold on that basis and bought repeatedly after proof by use.

Tested and found well adapted to the best circuits, *superdyne, superheterodyne, four-circuit tuner, neutrodyne, teledyne* and *inverse duplex.*

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SPOT STATIONS YOU HAVE HEARD WITH COLORED MAP-PINS.

Map size, 22 x 14 in., mounted on map-pin board. Shows all broadcasting cities, distance scale, relay and time divisions. Guide gives all call signals, locations, stations, wave lengths, etc. Price complete, 85c. Map-pins, 10c per doz. Any color. Above booklet with folded paper map, 35c. At your dealer or direct.

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Information Desk

(*Continued from page* 67)

More About the Wireless Age Three-Tube Set

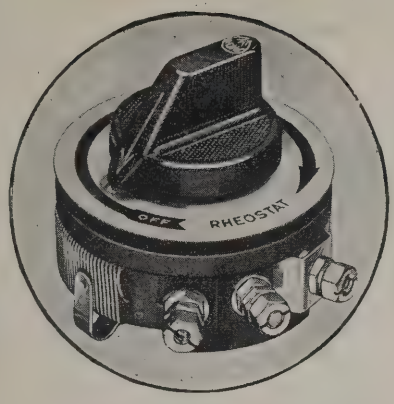
Many of our readers have written us, asking what the two binding posts between the Bradleystat and the grid variometer dial were for on THE WIRELESS AGE Three-Tube Set described in the March issue. As we mentioned in the article these two posts were to be connected to an external crystal detector mounted anywhere convenient, on the table or stand on which the set is placed, or on the wall, or some place free from vibration and out of the way, and at the same time in a position where it can be easily adjusted for best sensitivity. Crystal detectors mounted in a set, or on a panel are often awkward to adjust. The leads from these two binding posts run to the plate of the radio frequency tube and the B plus post of the first audio frequency transformer.

In experimenting with this receiver several types of crystal detectors were employed and the best and most consistent results were obtained with a compression zincite-bornite crystal that seemed incapable of misbehaving in the matter of adjustment. This crystal detector was made by the Westinghouse Electric & Mfg. Co., for the Radio Corporation of America for use in their sets, and proved to be just the thing for our purpose.

Many also wrote in about the two binding posts for the antenna. The diagram shown in connection with the article showed clearly how they were used. But it is evident that the explanation could have been made more clear. Just beneath the two binding posts marked "Antenna" are two small Micadon fixed condensers, one a .00025 mfd. and the other a .0001 mfd. These two condensers act as compensators for antennae of various lengths. After the set is connected up, the antenna lead-in should be brought to one of the two antenna binding posts and several stations tuned in. After noting the call letters of the stations, their approximate wavelength and position on the left hand dial, then disconnect the antenna lead-in from this binding post and connect it to the other and execute the same performance. Note which post gives the more desirable tuning range and stronger signal strength. Then use that connection. Bear in mind, however, that only one is to be used and that one is to be determined by the above method.

This receiver can be made a most satisfactory portable receiver for taking along on vacations, motor trips or on the yacht. Of course for the UV-201A's the dry cell tube UV-199 can be substituted. This receiver was tried out in our laboratory, using approximately 25 feet of No. 18 paraffined cotton-covered bell wire as the only antenna. WDAP and KDKA were brought in with loud-speaker intensity at six o'clock in the evening. The UV-199 tubes should be mounted on some sort of shock-absorbing base. This will not only prevent microphonic effects, but also decrease the possibility of ruining the tube through excessive vibration or shock.

Mr. H. E. Carter of Shelbyville, O., writes, "I built the special three-tube set described in the March issue and I was very much pleased with the results. I find it much more sensitive than any three-tube regenerative receiver I have ever tried. I won-



The Pacent RHEOSTAT *A Favorite*

The merit in the Pacent Rheostat is evidenced in its choice by leading radio authorities and its selection as standard equipment by leading set manufacturers.

It is ideal, considered from standpoints of design, operation and attractiveness of appearance. Construction in only two units simplifies installation. Fastening a single set screw insures against parts loosening or knob turning beyond its range. The Rheostat is supplied entirely complete with screws for mounting, knob and silvered dial.

Pacent Rheostats are made in a number of resistances for various needs.

Cat. No.	Resistance	Capac. Amp.	Price
85-A	6 Ohms	1.5	$1.00
85-B	10 "	1.	1.00
85-C	20 "	.6	1.00
85-D	30 "	.5	1.00
85-E	50 "	.3	1.00
85-F	2½ "	2.5	1.20
88	375 "	.2	1.25

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Pacent
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BLUE SEAL
Howard
Radio Co. Inc. GUARANTEED PRODUCTS Chicago U.S.A.

Your search for quality ends here!

The high quality of the Howard Radio Products is not a matter of "chance." Howard Radio merchandise is manufactured with extreme care and precision—by persistent efforts applied to the minutest details.

When you ask your radio man for a Howard Product you are getting the best. Your search for quality Radio Merchandise is ended, for Howard Products carry the guarantee of satisfactory performance.

STANDARD RHEOSTAT
This Rheostat gives perfect satisfaction under constant service. Special heat resistant base and knob. Fits all tubes —6½, 25 and 40 ohm...$1.10
Our new Rheostat with special dial is now ready—it requires but one hole for mounting. 6½, 25 and 40 ohm with special dial.....$1.20
Also made with micrometer attachment.

Discounts to Jobbing & Electrical Trades.
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MULTI TERMINAL PLUG
A positive connection for all standard receiver terminals. Acts instantly. Does away with all difficulties. Mechanically and electrically perfect. Accommodates up to 6 pairs of phones in series, parallel, or series-parallel connections. Multi Terminal Receiver Plug $2.00

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FREE Wonderful, home-construction, tube receiving set, of latest design.
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FIXED DETECTOR
TONE ADJUSTER-BAKELITE BASE
GUARANTEED—PRICE $1.25

Rusonite Perfect Radio Crystal Supersensitive.
Price Mounted 50c
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Improve your set with an AmerTran

Announcing
TYPE AF-7
(Turn Ratio 3½)

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TRADE MARK REG. U.S. PAT. OFF.

Type AF-6 (Turn ratio 5), has long been acknowledged the Standard of Excellence for audio amplification.
Type AF-7 is now offered for 2nd or 3rd stage amplification in conjunction with AF-6 for 1st stage. In this use AF-7 decreases the tendency to overload the last amplifying tube on loud signals. Price, either type, $7, at your Dealers.

American Transformer Company, 179 Emmet St., Newark, N. J.
Designers and builders of radio transformers for over 23 years

$200 SELECTIVITY for $8.50!

Make Every Night Silent Night!

TRAP OUT THE INTERFERENCE

Selectivity—which is merely the ability to cut out interference—is the dominating difference between the very expensive sets and the moderately priced ones. Why pay $50.00 to $200.00 extra for increased selectivity, when for $8.50 you can get a FERBEND WAVE TRAP *which will absolutely cut out any interfering station*, no matter how loud, how close by or how troublesome.

Add a Ferbend Wave Trap to Your Set

You will find it a valuable addition. It is designed and manufactured complete by us, after years of careful experimenting. It is not to be confused with imitations hastily assembled from ordinary parts. The price is $8.50. Shipment is made parcel post C. O. D. plus a few cents postage. If you prefer, you can send cash in full with er and we will ship postage prepaid. Send us your order today.

We guarantee that the Ferbend Wave Trap, when properly connected to any workable receiving set, will tune out any interfering station

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18 E. South Water St.
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FERBEND Wave Trap
PATENT APPLIED FOR

NO MORE CABINETS

JUST APPLY FLAT MAHOGANY OR PLATE GLASS COVERS TO THE NEW

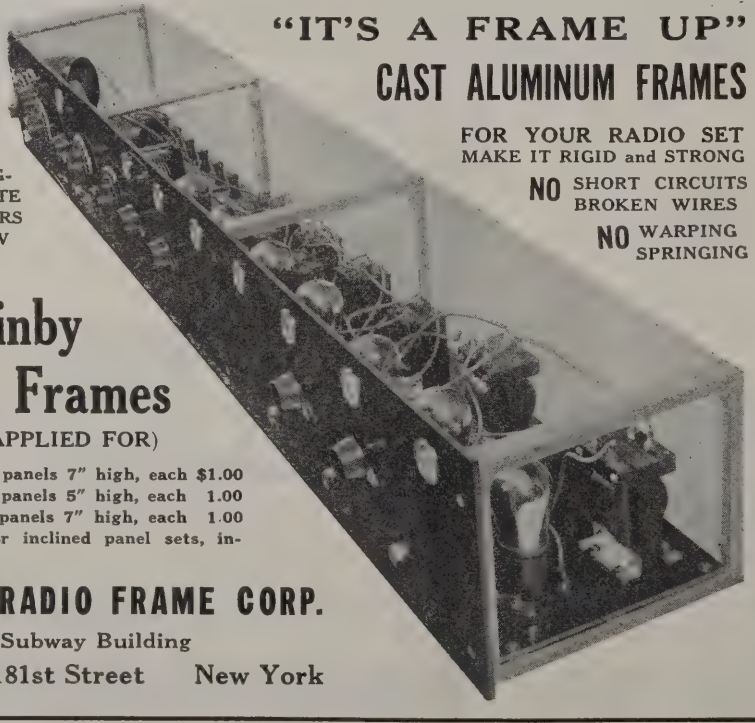
Quinby Radio Frames

(PATENT APPLIED FOR)

SIZE "A" for panels 7" high, each $1.00
SIZE "B" for panels 5" high, each 1.00
SIZE "C" for panels 7" high, each 1.00
(SIZE "K" for inclined panel sets, inquire)

"IT'S A FRAME UP"
CAST ALUMINUM FRAMES

FOR YOUR RADIO SET
MAKE IT RIGID and STRONG
NO SHORT CIRCUITS BROKEN WIRES
NO WARPING SPRINGING



QUINBY RADIO FRAME CORP.
Subway Building
587 West 181st Street New York

dered if I couldn't feed the output of the tune impedance radio frequency amplifier into, say, two stages of ordinary untuned radio frequency amplification. This, it seems to me, would make a very sensitive receiver, judging from the results that I have already obtained.

Fine! Mr. Carter. You took the very words right out of our mouth. A circuit hook-up for this scheme is shown on the special page of circuits in this issue. In this combination, the first stage of radio frequency is tuned—grid and plate—to the exact frequency of the incoming signal and the greatly increased signal voltage impressed across the terminals of an ordinary untuned radio frequency transformer and amplified in that fashion through another stage of radio. This puts an enormous signal voltage on whatever is used as a rectifier. A crystal detector in such a set would be shortly rendered useless, through burn-out or absolute loss of sensitivity. A hard tube detector such as the UV-199 or UV-201A should be used for best results.

A DX Receiver

Mr. B. J. Gregory of Lewistown, Pa., asks for the hook-up of a receiver with which he can tune in San Francisco and Los Angeles on the loud speaker.

Mr. Gregory, you really want an awful lot. Nothing short of a Super-heterodyne receiver will do this consistently.

Crystal Detector Must Make Contact

Mr. Jacob Arnfeldt of New York City has constructed THE WIRELESS AGE *Special Three-Tube Receiver described in the March issue, and reports very faint signals. He is using a fixed crystal detector.*

From our own experience, we should say that this crystal has been probably jarred from contact on a sensitive spot. If it is possible to adjust this contact by all means do so. If not, better purchase a good adjustable contact detector. When the crystal detector in this circuit does not make contact, the plate circuit of the first tube is opened and no signals are heard.

Dry Cell "A" and "B" Batteries

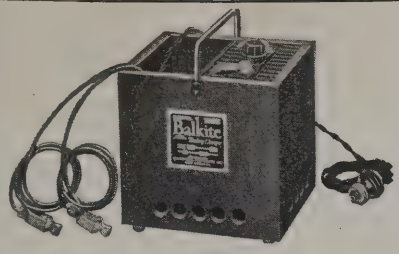
Mr. Iverson Nelson of San Francisco, Calif., wants to know what the difference is between dry cell "A" and "B" batteries and if it would be possible to make up a "B" battery out of a number of No. 6 dry cells.

The ordinary "B" battery really consists of a number of tiny dry cells (flashlight cells) connected in series to give the necessary voltage. Since the "B" battery does not have to supply as much current as the "A" battery it may be made much smaller. The "A" battery used with dry-cell tubes may be ordinary large size, No. 6 dry cells or in the case where a single UV-199 is used, flashlight cells. A very satisfactory "B" battery is made by connecting a number of No. 6 dry cells in series.

Two Tube Reflex

Mr. Howard Dreisbach of Peoria, Ill., wants a selective two-tube reflex hook-up.

This circuit is shown on the Circuit Page of this issue, together with necessary constructional data. He also would like to know the greatest length for an antenna to be used with this set. A single wire approximately 125 feet from the far end to the set, including all angles and bends, will probably best serve his purpose.



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Balkite

PATENTS APPLIED FOR *Battery Charger*

has no vibrators, bulbs or moving parts and is entirely noiseless

The Fansteel Balkite Battery Charger for Radio "A" Batteries [6 volt] is an entirely new type of rectifier, based on the use of Fansteel Balkite, a new and rare metal developed for this purpose. It is entirely noiseless. It cannot deteriorate through use or disuse. It has nothing to replace, adjust, or get out of order. It cannot discharge or short circuit the battery, and requires no attention other than an occasional ..lling with distilled water. It will not overcharge, and cannot fail to operate when connected to the battery and line current. It is unaffected by temperature or fluctuations in line current. It is simple, efficient, and indestructible except through abuse. The charger may be used while the Radio set is in operation. Without added attachments it may also be used to charge "B" storage batteries.

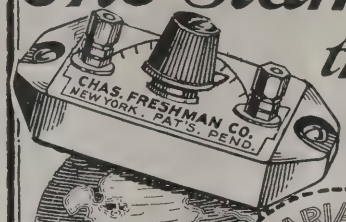
Price, $19.50 *$20.00 West of the Rockies*

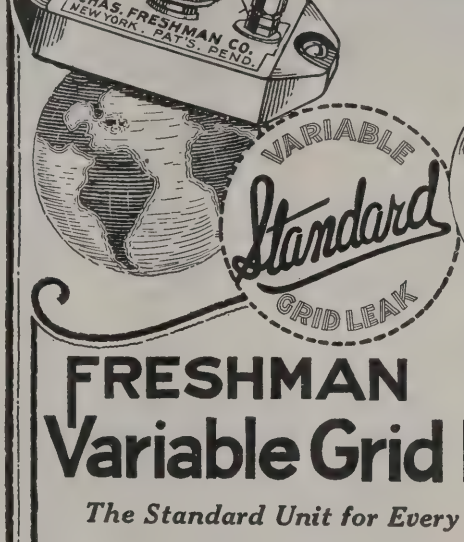
Fansteel Products Co., Inc.

Dept. 4-B North Chicago, Illinois

Tested and listed as Standard by Underwriters' Laboratories

The Stamp of Approval the World Over





FRESHMAN Variable Grid Leak

The Standard Unit for Every Tube Set

EVERY tube and every circuit require a different grid leak resistance. The method employed in the Freshman Variable Grid Leak permits you to adjust your circuit to any resistance you wish, from 0 to 10 megohms in an unbroken range of 180 degrees.

The Freshman Variable Grid Leak and Condenser combined takes the place of a grid condenser leak mounting and grid leak—and, in addition, permits an adjustment to the correct amount of resistance.

The Freshman Variable Grid Leak is the most compact, the most perfect, the most efficient, the most readily adapted to all grid circuits—and the only one which is entirely sealed and always remains unaffected by any climatic conditions. It is the

ORIGINAL VARIABLE GRID LEAK

Either Base or Panel Type Complete with .00025 or .0005 mfd. Freshman Condenser $1

Either type without condenser 75c

Ask your dealer or write for our free diagrams of Neutrodyne, Tri-Flex, Kaufman and Heterodyne circuits.

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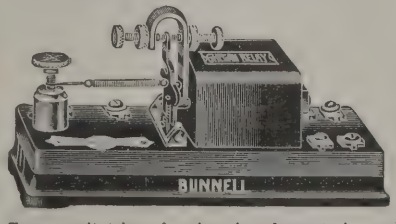
At your dealer's, otherwise send purchase price and you will be supplied without further charge.

GHEGAN RADIO RELAY



Taps permit tubes of various impedances to be used. With Bunnell Register this Relay will copy telegraphic signals at a speed of 60 to 90 words per minute.

With Siphon Recorder speeds up to 200 words per minute have been obtained. Normal operating current is ½ to 2 milliamperes. Send stamp for catalogue No. 45 W.

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J. H. BUNNELL & CO. 32 Park Place, New York City

Practical Wireless Telegraphy

By Elmer E. Bucher

More than 90,000 copies of this book have been sold—your copy is ready to be shipped.

Price, See page 73

WIRELESS PRESS

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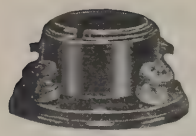
Na-ald No. 499

Na-ald Small Space No. 401

Cross Section De Luxe Socket

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NA-ALD

IT'S THE CONTACT THAT COUNTS

NA-ALD SOCKETS

For 200 Tubes
No. 400, Price 75c
No. 401, Price 35c
Three for $1.00
For U.V. 199
No. 499, Price 50c
No. 429, Price 75c
For W.D. 11
No. 411, Price 75c

The best radio engineering practice of today calls for the elimination of as much material as possible in the neighborhood of those parts of the set which carry the radio frequency current. This applies not only to metallic substances, but to insulating materials as well.

Na-ald Sockets provide for this by having uniform walls of Bakelite, giving the material its highest di-electric properties.

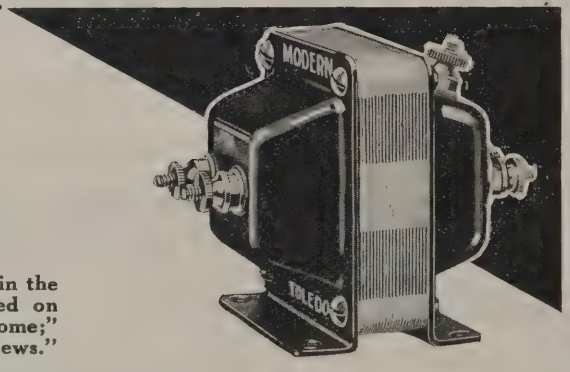
"Frying" noises, often attributed to B batteries, are in reality caused by poor connection. Na-ald De Luxe contacts not only press on the bottom of tube terminals, but cut into the sides, automatically making a bright, perfect connection.

No. 400 De Luxe is the standard for Neutrodyne and Superheterodyne Sets.

Send 15c or cover of Na-ald dial or socket carton for new Rotogravure Booklet, "What to Build."

ALDEN MANUFACTURING COMPANY
DEPT. K 52 WILLOW STREET SPRINGFIELD, MASS.

MODERN "Push-Pull" Transformers



These are the Transformers used in the hook-ups illustrated and described on page 13 March "Radio in the Home;" also page 1419 April "Radio News."

Radio authorities everywhere are unanimous in their endorsement of the MODERN "Push-Pull" method of power amplification.

MODERN "Push-Pull"
Used in addition to one or two stages of audio. Assures clearer and better reception than has heretofore been secured from audio frequency reception.

MODERN "Reflex"
This is the transformer that makes one tube do the work of three in the Monoflex circuit. Ask for the bulletin on the Monoflex circuit.

MODERN Standard Audio 4 to 1 Ratio
Designed especially for use in 2-stage amplifiers. Provides greater audibility than three stages using ordinary transformers.

Write for Bulletin!

This new MODERN Bulletin so thoroughly, yet simply, illustrates and describes the latest hook-ups that any novice can easily build the set he desires without the assistance of some more experienced radio fan. This bulletin is sent FREE upon receipt of 4c postage and dealer's name. Write for your copy to-day.

Modern Electric Mfg. Co. Toledo, O.

Your Dealer Sells MODERN Transformers
Most good dealers sell MODERN Transformers. Send for FREE Bulletin, then buy the MODERN Transformers you need from your dealer.

The Modern Electric Mfg. Co.
Toledo, Ohio

Can Build Set in Phonograph

Mr. Henry C. Hamilton of Westfield, N. J., wishes to construct a receiving set which can be installed in his phonograph and one that will give excellent tone quality.

If the Special Three-Tube Set described in the March issue of THE WIRELESS AGE had been specially designed for Mr. Hamilton, it could not better fulfill his needs. We recommend this receiver to him, knowing that it is ideal for his purposes. With this receiver we have used with very satisfactory results a 15-foot length of wire placed under the rug on the floor for an antenna. For best results, however, we recommend an antenna 125 feet long. Bare Number 14 copper wire should be used.

Convert into Three-Circuit Tuner

Mr. Herbert F. Evans of Wilkes-Barre, Pa., reports excellent results on a single-circuit "squealer" set and wants to know how to prevent annoying his neighbors without losing his present efficiency. He is using now a variocoupler and a variable condenser.

By purchasing a variometer of good make and inserting it in place of his present plate connections, and by connecting the rotor coil of the variocoupler to the grid and filament of his detector tube, he can convert his single circuit set into a three-circuit tuner. This, although it does not prevent oscillations from entering his antenna, will stop it to a great extent, if properly used.

Resistance-Coupled Amplifier

Mr. George Haynes of Hoosick Falls, N. Y., wishes to tell us that he has obtained excellent results with the four-tube resistance-coupled amplifier described in the December issue of THE WIRELESS AGE *by Mr. Abraham Ringel.*

Quoting his words, "It does everything the writer claims and far more. In addition to the most perfect and clear reception, he finds it possible to plug in several sets of headphones on the second and third stages without affecting the operation of the loudspeaker in the least." Note:—This can only be accomplished when using "single circuit jacks." Mr. Haynes used four UV-199 tubes instead of the UV-201A. He goes on to say that "THE WIRELESS AGE is the only publication I have ever been able to build a set according to their instructions, and have it work satisfactorily without subsequent alterations."

Aluminum Frames

Mr. M. Murphy of Belleville, Ontario, would like to obtain some of the Quinby Aluminum Frames used in constructing the One-tube Reflex Set described in the February issue of THE WIRELESS AGE.

They can be obtained from the Quinby Radio Construction Company, 587 West 181st street, New York City. Their ad appears in this issue.

Use UV-199 in "The Wireless Age" Reflex

Mr. A. Ford of Fitchburg, Mass., would like to build the one-tube reflex set described in the February issue of THE WIRELESS AGE *and would like to know if he can use a WD-12 tube in it.*

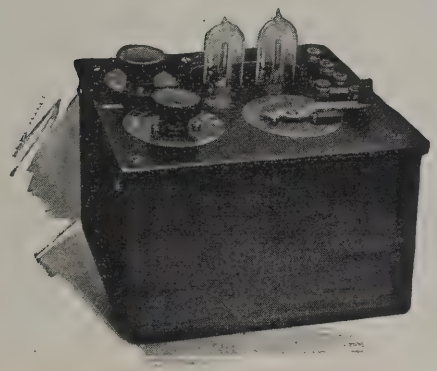
We would not recommend his doing so, as the WD-12 and WD-11 are made for use as radio frequency amplifiers. A UV-199 will probably work the best and a UV-201A will also give good results.

CONTINENTAL

"New York's Leading Radio House"

THE SYMBOL OF SERVICE

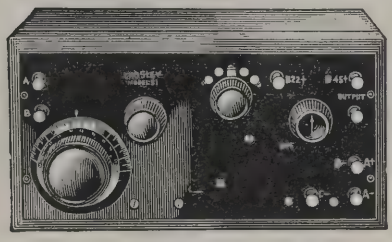
Radio Sets that produce a quick turnover



RADIOLA III

Standard radio receivers of the type shown here and which are nationally advertised need no introduction.

Dealers who have previously sold these receivers can well appreciate their sales building merits.



CROSLEY Model 51

The demand for summer portable sets has already started. There is no better medium to offer your customers than the Radiola III and Crosley Model 51.

We can fill your orders—can you supply the demand?

2174-Q

CONTINENTAL RADIO & ELECTRIC CORPN.

15 Warren Street **New York, U. S. A.**

Read

Page 73

Special Combination Offer

For this month only

B-Metal Crystal and Star Reflex Detector

Both for $1.50

Price 50c

B-Metal Crystals—The World's Standard

STAR REFLEX DETECTOR

Undisputed Champion in the Fixed Detector Field.

Price $1.25

Interesting Crystal Circuit Book Mailed FREE if you send your Dealer's Name.

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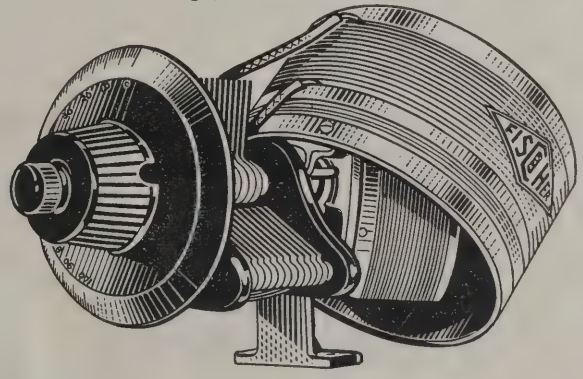

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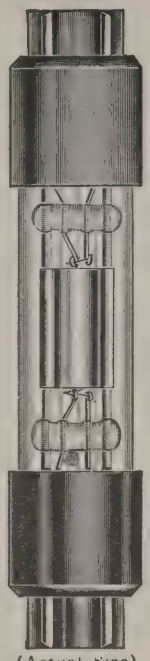
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By Elmer E. Bucher

PRICE—SEE PAGE 73

317 Questions and Answers

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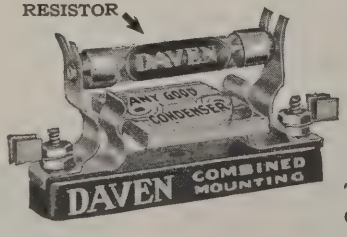

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(4ab), 4ajs, 4bz, 4cd, 4er, (4ft), 4fz, 4hs, 4it, 4jr, 4ll, 4my, 4oa, (4og), 4pk, (4rr), (4sh), 4xc.

5abn, 5aeq, 5agn, (5aiu), 5ajb, 5alo, 5alv, (5amh), 5bm, 5cc, 5cg, 5ka, 5kr, 5lp, 5nw, 5pk, (5ql), (5rg), 5rh, 5ua, 5wk, (5xa).

6aao, (6adt), (6ahp), 6avj, 6bbr, (6bbc), (6bnt), 6cb, (6cdg), 6cgw, 6ck, 6cyw, 6gt, 6hi, 6jh, 6py, 6xad, 6dp.

7ads, (7co), 7ih, 7kz, 7xd.

(8aeg), (8aig), (8alx), 8aoi, 8aol, (8aon), (8aq), 8aqo, 8aaj, 8atr, 8avj, 8axf, 8axk, 8bay, 8bdv, 8bfz, (8bwk), 8bvr, 8bvv, 8cdi, 8cei, 8cej, 8cjd, 8ck, 8cke, 8cun, 8cur, 8cuu, (8cwp), (8cwu), (8dgp), 8dhp, 8dhq, 8dia, 8dii, 8dm, 8eb, 8hx, (8ii), fone, 8na, 8nf, (8qb), 8rj, 8tj, 8tt, 8tx, 8vn, 8xe, 8zc.

9aal, 9ach, 9adp, 9ago, 9ahh, 9aia, fone, 9aid, 9ajw, 9amu, (9aox), 9apf, 9aqf, 9aqg, 9aqz, 9ash, 9asw, 9atw, 9awv, 9awy, 9axu, (9azj), 9bal, 9bbg, 9bcs, 9bez, 9bfg, 9bgx, 9bhy, 9bkk, 9biw, (9bkh), 9bks, 9bky, 9bn, 9bnu, (9bof), (9bqp), 9bqy, 9brk, 9brl, 9bvn, 9bya, 9cga, (9cgu), 9chf, 9chk, 9cju, (9ckh), (9cko), (9clx), 9cur, 9cvh, 9cyw, 9czj, 9czn, 9dbf, 9deq, 9dfb, 9dgy, 9dhr, 9dpr, 9dro, (9dtn), 9dwa, 9dxu, (9dvy), 9dzc, 9er, 9eji, 9ep, 9eld, 9ely, 9en, 9jc, 9lb, 9qi, 9ry, 9ty, 9xbe, 9xaw, fone.

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VOLUME 11

THE WIRELESS AGE

"America's Foremost Radiophone Review"

NUMBER 9

A Radio Reverie of Summer

BROADCAST stations are planning elaborate summer programs. Programs that will be broadcast with increased power. Programs of culture; of education; of entertainment.

The ocean waves will be broadcast from Atlantic City. The swish and boom of the breakers will reach the bed-ridden folk in hospitals.

The Democratic and Republican National Conventions will be held in New York and Cleveland during the month of June. While milling thousands swelter under auditorium roofs, radio millions will enjoy the Convention highlights under spruce boughs, on club verandas, in lake boats, and on front porches of an evening.

Summer sports, baseball, tennis, and boat races will go on the air. The open air band concerts of the parks will be broadcast.

All to be had for the tuning-in.

East or West is the seashore.

With the long rambling "Ls" and the wide, banistered porches of the sea-side hotel come our memories of the gala-day throngs leisurely strolling about on the spacious board walks. A group here, and a group there, discovering a gaudy array of souvenir booths with their baubles of canes and salt-water taffy temptingly arranged on tinseled shelves; gay little parties beneath red-striped awnings, scattered about on a green lawn; sober groups tucked away in the corners of the cool Palm Grotto; twos and threes, with tanned faces and sunburned arms, clad in vari-colored bathing suits lounging under the umbrellas stuck in the white, glistening sand, or racing down the beach and out into the breakers; music and gay laughter floating across the water from yachts idling off shore.

Glance again at the gay caparisoned seashore resort. The radio is there, because it adds to the things we like best.

Early up and out on the porch to see a sunrise in the mountains. We lean against the bark-log rail and strive to pierce the lavender shadows still hovering over the valley, two thousand feet below. The clear, translucent surface of Mirror Lake, streaked with shades of crimson and blue, reflects the heightening color of the morning sky. The evergreens and mountain ash on the distant shore carpet the valley like a rolling, moss-covered tundra. And up the mountain side they straggle out into squat bushes, then become more distinct as they reach the timber line. A riot of bright colored flowers cover a hillside that had been swept by a forest fire.

The sky has become a clear azure, with but one pink streamer melting into the zenith as the last remnant of a glorius sunrise warns us that another day of activity has begun. Hikes to be taken; long tortuous trails to explore; a picnic lunch on a rocky peak; a line cast into the icy water of a trout brook; a dip in the lake; and back again under the cool roof of pine boughs, to a supper of venison, and a dance in the evening. An evening of music that our radio provides.

The fascination of a city's pleasure in the wild, untamed realm of the mountains.

In an out-of-the-way corner, only known to vacationists, we have found an inland lake. A modest summer hotel is tucked away at one end. Around the bend, where the trees overhang the water edge, we find small screened-in cottages sheltering a neighborly group of families, crowded and happy, released from the inhibitions of side-street society, the ruthless tyranny of town existence.

We can spend a lazy, care-free afternoon on the porch, reading a novel, or listening in on the radio. Or perhaps we'd rather fish. With a box of tackle, a pail of minnows and a portable receiver, we can row from shore, and to the strains of an orchestra troll for pike.

In the evenings we have the best in news and entertainment by radio. On a Sunday we gather in the old fashioned parlor of the hotel for the religious services broadcast from the temples of worship in the great cities.

We have the best of our civilization in the peace and quiet of woods and lakes.

Those of us who are city-bound—shackled to a desk in the oven heat of an office building, grinding away under the irritating draft of an electric fan—those are the ones of us who will know the value of radio this summer.

We can find surcease from the tense, vibrating grip of the day's business at our radio of an evening.

We can have a garden party, or a lawn fête, during the longer daylight evenings. The best metropolitan hotel orchestras will play for us.

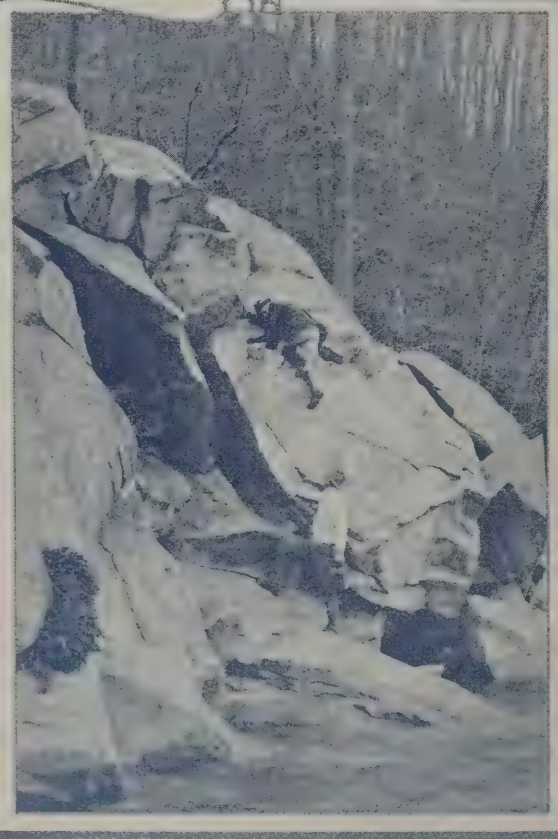
We can lounge on our front porch and listen to broadcast talks on week-end motor trips; where to go, and how; when to go, and why.

On a Sunday we can drive to the neighboring woods for a picnic lunch. And under the spreading branches of an oak, listen in to religious services, mingled with the strains of an organ, the best of majestic cathedrals brought to us in the sanctity of peace and rest in the open air.

Enjoying Summer Radio and—

Radio dispelled the loneliness when getting the garden ready at this summer cottage before the family arrived

Radio has become indispensable in Boy Scout and Army summer camps. Excellent results were obtained with this equipment



A natural cave runs in to the left and cannot be approached other than down the rocks as shown. After the radio had been installed the retreat was transformed into a homelike camp

Through radio, the youngsters are receiving swimming lessons broadcast from WLW. These classes are under the auspices of the Y. M. C. A.

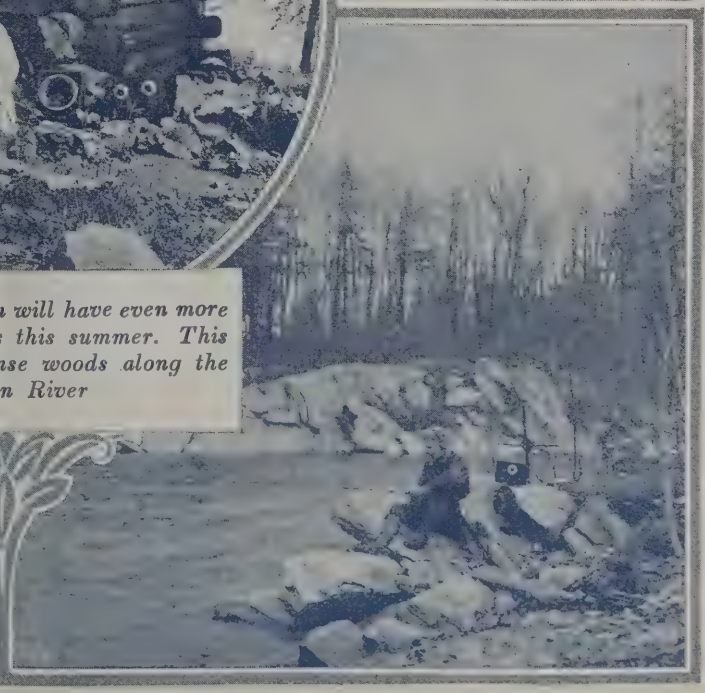
Woodland, Stream and Sea Shore

A book of verses, a bit of lunch and the radio underneath a bow—a pleasant hike the more pleasant because of radio

Radio on the beaches this summer will be a part of summer vacationing and sports. It can best be enjoyed beneath an umbrella between times of dips in the sea

A log cabin vacation will have even more lure for radio fans this summer. This scene is in the dense woods along the Hudson River

This is an example of what can be done with a good portable set on the camping trip this summer. The aerial is a single wire thrown over the limb of a nearby tree



The hours of fishing can be considerably lightened with a good radio set. This is a six-tube set. The labor of carrying the dry batteries was well worth the result

The Cruise of the Ara

The Story of a Millionaire's Yacht. What Radio Means to Mr. W. K. Vanderbilt Aboard the "Ara"

By William A. Hurd

SAILORS, ashore, enjoy the privilege of using sea-going phraseology to the confoundment and envy of all landlubbers. Such is a mark of distinction.

But once a son of the soil climbs aboard ship—he is an object of pity, a target for ridicule, a stranger to Oceanic Jargon, and his criminal ignorance is dealt with after the fashion of the high-seas custom. He is expeditiously squashed, and flung into the scuppers.

A floor's a deck, a kitchen's a galley and a stairway's a ladder. Every salt knows it, down to the last sea-dog who has roamed the highways and the byways of the seven seas.

So we'd better look sharp to our riggin'—we're going on a cruise. The cruise of the *Ara*.

A trim little yacht, the *Ara*. 213 ft., fore and aft, with a water displacement of 850 tons, equipped with two 1,050 H. P. Diesel engines and run by a crew of thirty-two men and officers.

The Commodore, W. K. Vanderbilt, railroad financier and scion of the well known Vanderbilt family, purchased the *Ara* following the Great War, and refitted the yacht to suit his needs. Since the total cost was approximately $500,000, one might gather that yachting is, indeed, a luxury. And one is correct—members of the crew consider it a luxury to work on the *Ara*.

Four boats are swung on davits: a thirty-foot motor cabin-launch for the Commodore's private use, an eighteen-foot motor dinghy, a twenty-foot motor launch, a twenty-six-foot life boat, and between them, on the superstructure, waterproof lockers contain rigging, auxiliary storage batteries and jars of diluted formaldehyde in which fish specimens are preserved. Nothing to inspire romance there.

The Wireless Age is indebted to Mr. W. K. Vanderbilt's kindness in allowing the writer to go on board the "Ara" in order that a description of the yacht and particulars of the log might be combined in a story. By way of enlivening the story, the writer has on his own initiative added a touch of romance.

Strolling up to the pilot house, signs of life become apparent as the wheel and engine room signal controls are uncovered. The Mate bends over the gyroscope compass checking its working order. When asked, he explains that unlike the magnetic compass, as of old, this one operates electrically from a gyroscope located in the bottom of the ship.

Stepping into the chart room, we find a sailor putting the finishing touches to his brass polishing. The Second Mate is checking the chronometer and arranging the great number of charts and maps. Here, every instrument practicable to navigation may be found. And frequently in duplicate.

Out on the bridge an electrician is testing the electrically controlled Sperry searchlight, fastened above on the foremast. This light is the most powerful built for ships, capable of throwing a strong beam of light several miles.

Leaning over the rail, an increasing hustle and bustle is observed. A pungent odor of whale oil drifts up from below where it is being rubbed on to metal parts that are exposed to salt spray. The davits creak and groan as the provisions are swung aboard. Up forward one of the Boatswains leans against a canvas-covered gun, listlessly checking the supplies as they come over the bulwarks. An almost imperceptible motion of the yacht is detected as she idly swings at her mooring.

Below, the crew's quarters occupy most of the forecastle. Just aft are the officers' quarters and the radio station.

Steffen F. Nielssen, a World War veteran, is in charge of the radio station. Before the war he attended one of the prominent universities in Germany and is conversant with several languages. His first schooling in radio was under the personal direction of Poulsen, inventor of the Poulsen arc transmitter. Later he conducted the radio research work in the laboratories

of the University of Texas for a period of two years.

Just now, he is wholly absorbed with the intricate circuits, looking for a broken wire, a loose connection or any weak point that might cause trouble at sea.

So we'll look around aft where the steward's quarters are located. In these quarters accommodations are provided for six stewards and chef. A laundry is also provided below.

Amidship is a large music room luxuriously furnished with a gray plush carpet, overstuffed lounge and chairs, rare mahogany pieces, a grand player-piano, a console phonograph, floor lamps, a large bookcase containing valuable editions, and side-wall candle fixtures. Loud speakers can be "plugged in" at convenient outlets connected by direct wire to the broadcast receiver which is located in the radio operating room.

Stepping out of the music room, the passageway leads aft between cases of sea and bird specimens, racks of firearms, some of a special sort, and lockers of nearly every conceivable kind of fishing tackle. A sportsman's yacht, and no doubt about it.

Through this passage, entry is had to the sleeping accommodations for the guests. There are six suites, each with private bath. The beds, dressing tables, desks, cabinets and chairs in each suite are of a uniform style. In one, mahogany, another bird's-eye maple, and others, walnut, oak and various costly woods.

Leading up the ladder, we may step into the card room appointed in the fashion of a "club room" coziness. Heavily cushioned benches surround a table, and panels of matched grain form the walls or bulkheads.

The galley (kitchen) is a model of spotlessness, where Commodore Vanderbilt's private chef reigns supreme. The prepared meals are sent below, for the officers and crew, and above, for the guests, on a dumb-waiter. Should any of the company be delayed, the food is kept warm in an electric heater.

On the main deck is a large and airy dining saloon which is connected with the pantry from which the food is served. The table is pivoted on gimbals so that it remains on a level plane when the yacht rolls and pitches in high seas.

Going below again, we see the ice-boxes. They resemble the finest in a metropolitan hotel.

Provisions are being stored away for this cruise—chickens, meat, canned goods and an infinite variety of delicacies that make our mouths water, merely to contemplate the good "feeds" ahead.

But our epicurean reveries are interrupted by a shrill whistle from above. Having gleaned enough sea-etiquette and ship manners by this time to know that a whistle sounded portends something of significance, we scramble up the ladders to investigate the cause.

Commodore Vanderbilt has come aboard. Brisk, orderly activity is evident at every turn. The Commodore, having been a Commander in the Navy, always insists that precise conduct should be the mark of efficient management aboard the *Ara*. And so it is.

His first concern, before casting off, is about the navigation equipment. Then below to inspect the radio.

The radio apparatus is a duplicate, throughout, of that on the *Majestic* of the White Star Line.

Three transmitters are installed; a 1½ K.W. tube transmitter, a 1½ K.W. spark transmitter of the quenched type and a smaller spark transmitter, rated

STATEMENT FROM MR. W. K. VANDERBILT

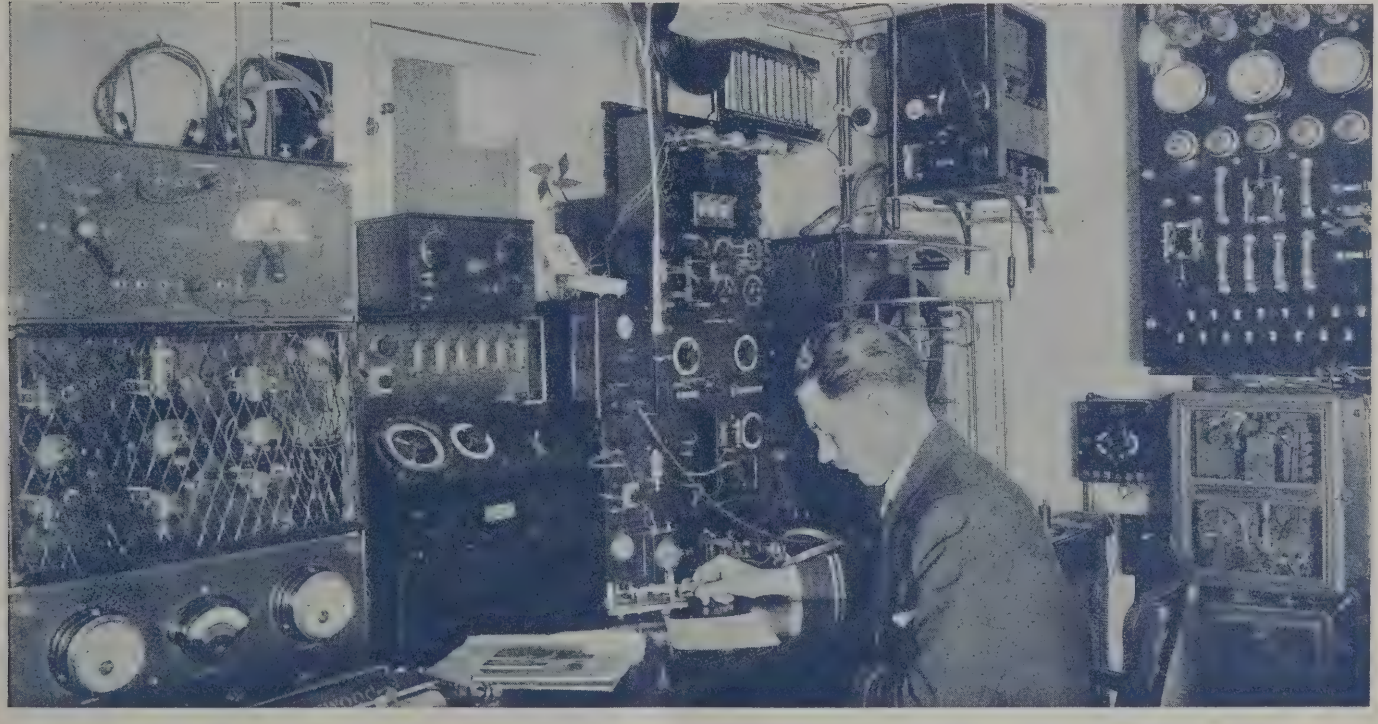
"It is a pleasure to state that radio has been a useful hobby as well as a really worth while diversion.

"At times I am several thousand miles from home and the office. In the past I have been at a loss to know what might have happened during my absence, and the knowledge that something might be wrong has frequently been uncomfortable since I would not hear of it until many days later. But now I am in constant touch with home affairs, and possible business matters that might require immediate attention. And this is possible through the modern radio equipment on the Ara.

"The reception of news has added much to the comfort of my crew, guests and myself. Through the agency of radio we enjoy a daily newspaper on board the yacht, however far from the land.

"From a navigating standpoint radio has proved invaluable. The Direction Finder has been a great aid in coastwise sailing. We feel that when within 50 miles of two stations our position can be checked within a degree.

"The time signals and the weather reports, and the fact that one may communicate with the outside world, have all added to the pleasure of a cruise." —W. K. Vanderbilt.



Steffen F. Nielssen, the operator aboard the "Ara," at work. Left to right is the C. W. transmitter, the direction finder and gyroscopic compass, the two receiving sets and loud speaker (above) and the main spark transmitter (partly hidden by the operator's head). Above the main transmitter is the emergency spark transmitter and to the extreme right is the switchboard, and below, the motor-generator starter.

at ¼ to ½ K.W., intended for emergency use, or for low power transmission.

A motor-generator supplies the power for all three transmitters.

The switchboard carries all the control switches for the main set and the emergency power, besides providing means for charging the storage batteries.

Two receiving sets provide the traffic and broadcast reception. The broadcast receiver is connected to a three-step power amplifier.

Mounted on the table is a radio direction finder that is often more accurate than navigation instruments.

Next to the direction finder is a "repeater," part of the gyroscopic compass system.

Although atmospheric conditions, and many other factors, largely determine the range of any radio equipment, the apparatus aboard the *Ara* consistently maintains a transmission record of 1,500 miles.

Commodore Vanderbilt, well pleased after his inspection, climbed up to the bridge, questioned the Staff Captain on some matters pertaining to the general working order of the ship, and then gave orders to cast off.

* * *

A bell sounded — the engines throbbed — the water boiled and churned away from the stern—the *Ara* swung gracefully from the dock—her nose pointed seaward — long, black rolls breaking into swirling eddies broadened out into a fan-like wake—the topmasts like slender, artistic finger tips seemed to inscribe the words ROMANCE and ADVENTURE on the moist mirror of the sky.

The *Ara* slipped down the Hudson River, tooting her course through a maze of ferries and tug-boats; down between the batteries of wharves and docks; down between sheer cliffs of brick and steel buildings. The evening settled into deepening twilight; lights began to twinkle; red lights, green lights and white lights drifted across the water; the New York skyline melted into a fairyland of gleaming jewels and towers; the far-off, muffled roar of the great city drifted out as from an enchanted world; perhaps it was the trumpeting of heralds from the turrets, proclaiming the freedom of souls from another day's toil.

Across the harbor, out into the ocean, the *Ara* nosed along, pointing toward beacon lights, then following the boom of buoy horns; still out, around Sandy Hook, and at last, straightaway, due South!

The following day, the *Ara* pulled up in the sheltered water of Chesapeake Bay long enough to cast over some lines. But fisherman's luck had stayed ashore. Other than three or four small sharks—disparagingly referred to by the natives as dog-fish—the only catch that furnished any excitement was a sting-ray. This fish, very much resembling a kite, its mouth about where the kite-string would be attached, spread itself out in such a manner that a three-foot board, hauled broadside through the water, would have offered less resistance.

The Commodore wished to send a few radiograms, so a day was called. The yacht headed out to sea again, and Nielssen cut in the broadcast receiver for the daily DX dozen.

Most of the guests went ashore to visit the old historic fortress at Fort Jefferson.

In the music room, the Commodore and his party enjoyed a concert from New York, while the crew, below, listened in on another loud speaker.

Four bells sounded on the bridge. Simultaneously the time signals from Arlington flashed the long dash for 10:00 P. M. In the chart room, the Mate checked the chronometer, and then sent the Quartermaster below for the weather reports. Such was the nightly ceremony that radio had dedicated to the precise art of navigation. It was a solemn affair because it was important. A ship at sea must not be left to the caprice of human judgment.

* * *

The *Ara* arrived at Jacksonville with no mishap and a record of fine weather. Milk and fresh vegetables were brought aboard. And then the crew set to the task of scrubbing and painting until the yacht, from topmast to keel, was as ship-shape as a Bo's'n could wish.

The following day, the *Ara* slipped into the harbor at Miami and dropped anchor to await the arrival of the guests.

On the way in, one of the sailors, who had been up in the rigging, swung out on a cable and waited. A few moments later a schooner hove alongside on the way out to sea. The sailor, hanging in mid-air, let go. He soared out over the bridge, gripping the cable with his hands and one leg hooked over the top. He soared out over the pilot house and down; down with increasing velocity; down with a crash to the deck.

The men aboard the schooner had watched, spellbound. An old salt rushed over to the rail, and with cupped hands to his mouth, yelled, "Good work, sailor. Better ship over on a square-rigger afore your seal'arnin' runs amuck!"

The sailor grinned acknowledgment. He had been educated on a sailing vessel, and he knew that old timers, alone, would understand the urge that had prompted his little display of vanity—or perhaps it was pride. He looked at his hands. The palms were scorched by oakum, and raw. He grinned again.

The Mate, who watched the episode from the bridge, also grinned.

Two men aboard the *Ara* had known the wild thrill of hanging to a yardarm, taking in a reef against a driving storm, the canvas tearing the flesh from clutching fingers, the topmast slashing through the darkness in terrifying arcs.

The guests came aboard in the evening. Under the clear, Florida moon the party danced on the quarter-deck to the strains of an orchestra broadcasting from New York. Around midnight the music stopped. Stewards brought chairs and cool drinks, and the guests gave themselves up to the luxury of reclining beneath the high, star-dotted vault of a Southern sky. Refreshing zephyrs skipped across the deck. The soothing trickle of water, breaking against the bow, whispered strange yarns of the sea. Delicate, phosphorus-streaked patterns of lace spread over the surface, glowing and

fading, the half-formed pictures, ever elusive, always beyond the grasp of intrigued fancy.

A steward came up to announce that the operator had managed to tune in another orchestra, broadcasting on the Pacific Coast. And did they wish to dance? They did!

An hour later, the party had to retreat to the music room to continue their dance because of the mist that had settled over the harbor. And the dance continued until the last broadcast station had closed for the night.

In the morning, the *Ara* left Miami for Key West for fuel.

Key West is south of America—1,500 miles south of New York—and yet it is indubitably a part of America. It is, in fact, disappointing.

The low wooden houses have wide verandas supported by pillars resembling the tropical abodes of a Latin people. But they smack of our own familiar architecture.

Here and there, a graceful palm tree rises from the curb, the delicate plume-like branches drooping and swaying in the constant sea breezes. For a moment, one can picture the olden days when pirates took refuge in the bosom of these coral islands, scarcely rising above the ultramarine blue of the Caribbean. Then disillusionment. The swarm of automobiles clogging the street corners are very modern. Automobiles can even destroy the tranquil memories and jealously guarded traditions of a sleepy, New England village.

Year-round prevalence of mosquitoes and the acute lack of drinking water irritate the visitor from the States. The natives, however, accept the two evils with a resignation that surpasses the comprehension of restless, American-born citizens who are frequently guilty of acceptance without reason, but never resigned.

Innumerable cigar factories clutter the island. Modern factories, well ventilated by the steady breezes enjoyed in Key West, less pretentious structures down the side streets, and small, single shanties tucked away in stuffy corners of the town, all house the great industry of this natural focus point of material, maker and consumer.

Two sailors from the *Ara* went ashore with a misconceived idea of Key West generosity, and a goodly share of blissful ignorance. It occurred to them that a casual tour through the plants of better cigar manufacturers would result in pockets full of brands ordinarily beyond their means. They found the factories extremely cordial—almost grateful for such unprecedented concern from two perfect strangers—but courtesy in a Key West cigar factory does not include the ritual of tucking samples into comfortably receptive vest pockets.

While the guests aboard the *Ara* sauntered about the town, oil was pumped into the tanks, located in the sides of the yacht.

A sponge boat had just returned from an expedition in the sadly depleted sponge fields of the Florida Keys. The boat reeked with the putrid, nauseating odor of decayed animal matter.

The *Ara* left Key West for a run around to Fort Jefferson. Some of the guests went ashore to see the old historic fort of Civil War days.

The chase after the queer "balloon" fish resulted in the catch of a large jewfish

The few who remained on the yacht whiled away the time by fishing off shore. Three small fish were caught, hardly worth saving, so they were cast out into the water. But one swelled like a balloon and floated away on the tide. A boat was launched to recapture the strange specimen.

Although the balloon-fish could not be found after a diligent search along the course it had been last observed floating out to sea, a large jewfish was caught on a troll-line. This was brought back to the dock, cleaned and preserved for the Commodore's museum.

The following day, the *Ara* was headed around and set on a course for Nassau in the Bahama Islands.

Before land was sighted a strong trade wind blew up from the West Indies. Its velocity increased steadily, followed by giant rollers that broke into whitecaps. The yacht plunged, nose first, into a towering wave. She hesitated for a brief instant; a sheet of green water splashed up from the bow and swept across the bridge; the ship quivered, and then rose with a sickening sweep; up, and faster; she paused; and then dropped like a meteor into a yawning chasm; dropped like a thing gone mad. Head on into another mountain of water. The bridge was again swept with a drenching wave. Cold, foam-flecked water washed over the deck. The air was filled with chill, sticky spray that foreboded "weather" during the night.

"Pretty mean out," the Captain mused. "Barometer's dropping like it didn't know it had a bottom." He had addressed no one in particular, but the Pilot laughed.

"Don't worry, Captain," the Mate bantered, "there's a bottom to everything—even the ocean."

All afternoon and well into the evening, the Commodore checked his bearings on the radio direction finder. At 9:30 the storm broke with a fury approaching a typhoon. Rain poured down in solid sheets of water, twisted and lashed by the wind.

The telephone rang in the pilot house. The Commodore grabbed the receiver, listened, and then shouted the command to the Quartermaster: "Turn the searchlight on the loop aerial of the direction finder! It's broken! Nielssen calling!"

Then turning to the Mate: "The operator has to stay at the radio—anyone aboard who can repair that loop—right?"

The Mate remembered the sailor who had risked his life in Miami merely to prove his seamanship. "Aye, sir," he replied, then called the man up, curtly explained the trouble, and sent him out to do the job—right.

Under the glare of the Sperry light, the seaman worked fast, efficiently. He seemed to be hardly aware of the raging elements. He had the wire. A quick splice and it was fastened to the insulator. He slipped to the deck below, and was swallowed in the darkness.

A moment later he reported in the pilot house: "Done, sir."

The Commodore smiled. "Good! We need that direction finder tonight. Better report in the galley for a bowl of Java."

Radio for Boatman, Motorist or Hiker

Practical Vacation Pointers

The author is a practical boatman and has installed radio on boats of all kinds. He is a practical radio man and has used radio on automobile trips. He tells just how it was done; just what to avoid

By W. F. Crosby

THE perpetual grouch, who goes around broadcasting the fact that radio is doomed for a terrific "bump" during the coming summer, is going to have a rude awakening, one of these fine mornings. He is going to wake up and find that radio has taken hold of the popular fancy more than ever and that radio and vacation are practically one and the same thing.

The forehanded radio fan is the fellow who has made preparations far in advance, who has spent about half the winter in preparing and building a good set which he can take along with him on his vacation, or on his week end outings, whether they be on the water, by car, or just plain "hikes."

Such a man as this has had time to study the situation and the circuits and, by now, he is pretty well versed in what is what in the way of summertime radio; but there are always hundreds who have not looked so far ahead and it is to this class that this article should have its particular appeal.

Broadcasting seasons change, just as in any other industry, and the leading broadcasters are planning some fine things for the hot evenings. Dance music will predominate and what could be more enjoyable than to be anchored in some snug cove for the night with the old loud speaker pouring forth the strains of the latest dance hit. Or you might be tucked away in a tent, somewhere in the mountains, possibly during a rainy stretch. The morale of the whole camp will be brightened up if only a good radio receiving set is on hand, and, it might be added that good music, under such circumstances, sounds about twice as good as it ever did before, or will again.

Oh, yes, it is quite possible to make up small portable sets which can easily be transported on the back, and such little sets as this are frequently even more efficient than their larger brothers.

Consider the little UV-199 and what it makes possible. Here is a tube which draws such a small amount of energy from the "A" battery, that it is possible to run it from an ordinary flashlight cell! With such a set as this, employing several of these tubes, you will be able to have an outfit which will weigh next to nothing, when we stop to consider the more cumbersome batteries required with the six-volt tubes. Even the ordinary dry cell tubes, such as the WD-11 and WD-12, require larger and heavier batteries, for the simple reason that they draw a great deal more current from the "A" battery.

If you choose, you can make up a simple little one-tube set, using a 199, and the whole thing may be enclosed in a space considerably smaller than the average haversack. If you want to make use of what is known as a mercury condenser or a compression condenser in such a set as this, the total size of the panel need not exceed

An automobile trip will not be complete this summer without a radio set. Many a picnic lunch will be more enjoyable accompanied by radio music

six inches square, by possibly six or seven inches deep. There are plenty of simple circuits to choose from, but bear in mind that such a set will surely require an aerial. This will necessitate some form of reel or winding machine, where the wire may be kept when it is not in use. Such a simple thing as this will never feaze the average radio fan.

Then, if you wish, you may take advantage of radio frequency amplification, because the 199 tube is a mighty good radio frequency amplifier, and you may rig up a set which will contain several stages of untuned radio frequency. Of course there is no law against the use of tuned radio frequency, but it will make the set considerably more cumbersome and heavier. Some radio fans think that reflex circuits are the best for this kind of work, and if such a set is properly designed and built, it is quite possible, with three tubes, to make an outfit which will bring in broadcasting with sufficient volume for a small loud speaker. Such a receiver may be completely enclosed within a cabinet fifteen inches long, or even less, if you squeeze the parts up a little. The flashlight cells may still be used for the "A" battery.

In the reflex type of circuit, each vacuum tube is used over twice, once at radio frequency and again at audio frequency. Using a small loop aerial is a practical proposition, if the set is built right. Of course a regular aerial will give far better results, especially

Courtesy of Mullins Non-sinkable Steel Boat Co.

A suggestion for campers

on long distance stations, but if you happen to be camping within a fifty mile radius of some broadcasting station, you may rest assured that you will at least hear that station, and if circumstances are right, you may do even better.

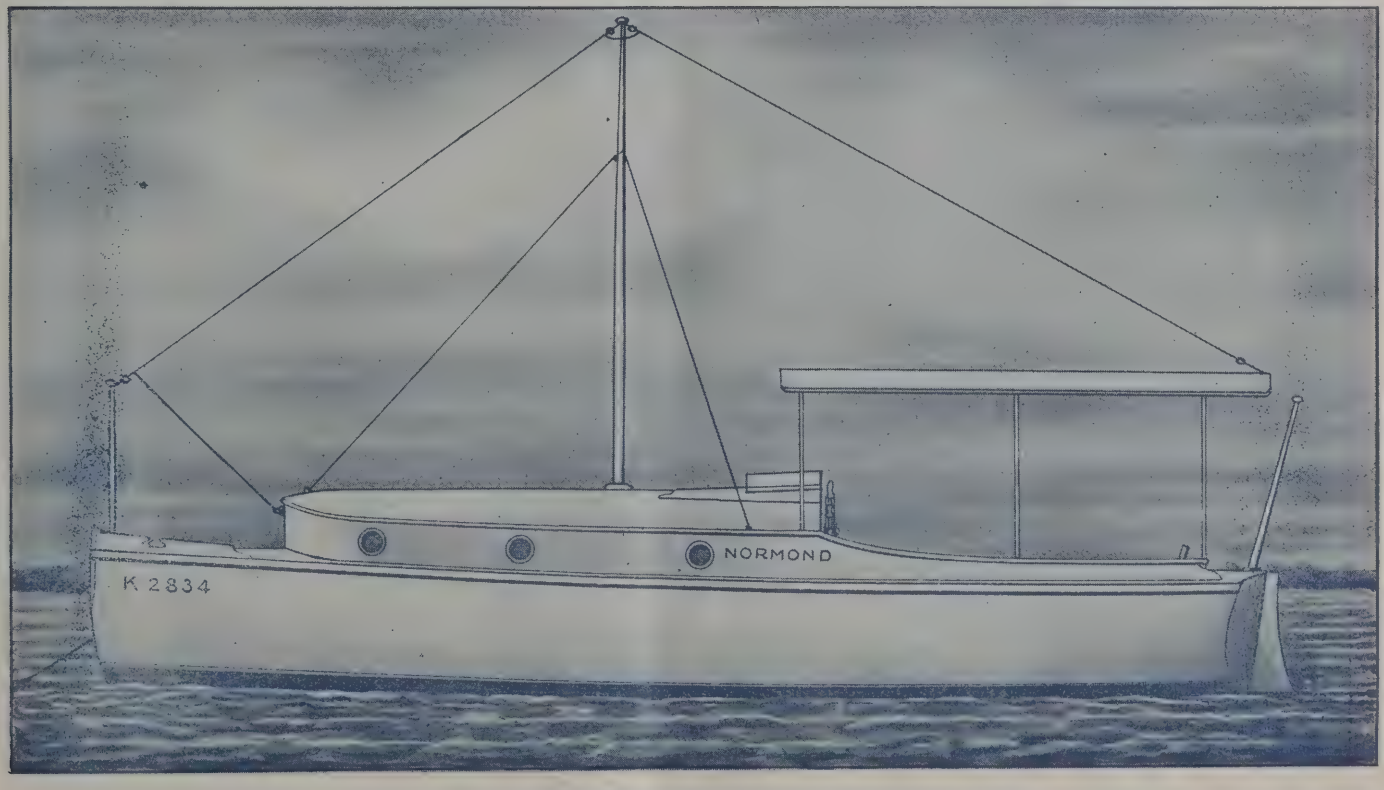
These little sets, of which there are many variations, will prove excellent for hiking and canoe trips, where space is small and the weight must be kept down, but when we come down to the motor boats, we find that the problem is considerably simpler. The main trouble seems to be in getting a suitable aerial, and possibly the accompanying sketch will give an idea of what can be done on a rather small cruiser of about thirty feet.

In this particular case, the aerial is started at the top of the awning, way in the stern, and it is carried up to the top of the mast and thence down to the bow, where the lead-in wire is taken off and run in through the forward end of the cabin. There are many variations of this, but for the particular type of boat shown, such a rig cannot be beaten. It will give the maximum over all length to the aerial, something which is quite essential for good reception.

If two wires are run in the same manner, it is advisable to use some form of spreader just as near the top of the mast as possible. By keeping the aerial high up in this manner, the overall length is slightly increased. Every inch counts, especially on small boats.

Again referring to the sketch of the boat, you will notice that we have a small insulator at the bow, two at the masthead and one at the top of the awning. The masthead rig is simply a bridle with an insulator on each end, through which the aerial wire is passed, and then hoisted up the mast by the regular halyard. Such a rig as this is easily taken down at any time.

Now as for the ground, when you are on board boat, you have plenty of that all about you, despite the fact



An excellent aerial system on a small yacht or for the larger motor boats

that it takes the form of water. The only thing that is necessary is to make some connection to that material. This is sometimes accomplished by fastening a wire to the engine at some convenient place, allowing the shaft and propeller to do the rest. This rig is sometimes satisfactory, but a far better way is to have a copper plate attached to the outside of the hull, below the water line. There is only one difficulty here, and that is with the electrolytic action between the fastenings of the hull and the copper plate.

A combination of the two metals in salt water will always make trouble unless well defined rules are followed. If your boat happens to be fastened with brass screws or copper nails, then it will be all right to attach a copper plate to the hull, but be sure to use copper tacks in doing this. On the other hand, if the boat happens to be fastened with galvanized iron nails, then it will be far better to use zinc in place of the copper plate. Galvanized tacks should be used to hold the plate in place. It is also not advisable to allow this kind of a plate to come too close to the bronze propeller and shaft, because you will find that the plate has been eaten completely away after a month or two in the water.

One more thing while on this subject: try to avoid the use of solder, especially soldering to copper or soldering a copper wire to a zinc plate. Such practice is extremely bad underwater workmanship and it will not be long before you have no connection at all.

Instead of this, fasten the wire in place by means of screws, or by punching holes in the plate before it is attached and then threading the wire back and forth through these holes until a solid contact is made.

As for the set itself, we have a wide variety to choose from. Of course the old fashioned regenerative outfit will work, after a fashion, and in some cases extremely well, but it is more or less of a gamble as to just how it will perform. You will probably get a much stronger signal by resorting to one of the newer circuits, tuned radio frequency, neutrodyne, super-heterodyne, or reflex. Size governs to some extent, when we realize that great space is not always available. Of course some of the larger motor boats and yachts will have plenty of room for the most elaborate set, but this is far from true on the smaller cruisers.

Most of the present day motor boats are equipped with electric lights and it is not a difficult matter to arrange some means of taking off a pair of wires from the storage battery. There is one point to look out for in this respect. This has to do with the voltage of the battery.

In a great many boats the system calls for twenty-four volts and of course this will never do for a six-volt vacuum tube. For this reason it will be far better to call in an experienced electrical man and have him arrange for a six-volt line. If you have a large storage battery and are not sure as to its correct voltage, count the vent caps. If there are three of them, then you may be pretty sure that the voltage is just six, because each cell in the battery will give two volts and since there are three vents, there must be three cells. If you happen to have a battery with more than three vents in it, then you had better have it checked up carefully.

The writer has seen some yacht installations where the radio set has been tucked away in a locker with the loud speaker arranged so that it can be plugged in at different positions on the boat, either inside the cabin or in the cockpit. This does not call for much radio knowledge and anyone who has been able to build a radio set can easily figure out such a scheme.

In one rather elaborate outfit, the receiver had been built into a bulkhead desk and was completely concealed when the desk was closed. The set in question consisted of an ordinary detector and two stage amplifier with a horn arranged in the corner of the cabin, way up under the deck beams where it would never get in the way of anyone's head.

Of course, the large yachts are nearly all equipped with radio sets at the present time, many of them carrying regular licensed operators. These operators frequently have life rather easy and many of them have rigged up broadcast receivers for the yacht owners. Such installations are, of course, outside the scope of this article.

Easily the most popular sport today is automobiling, but radio is running it a close second and the day will come when the two will be combined to give the vacationist the time of his life.

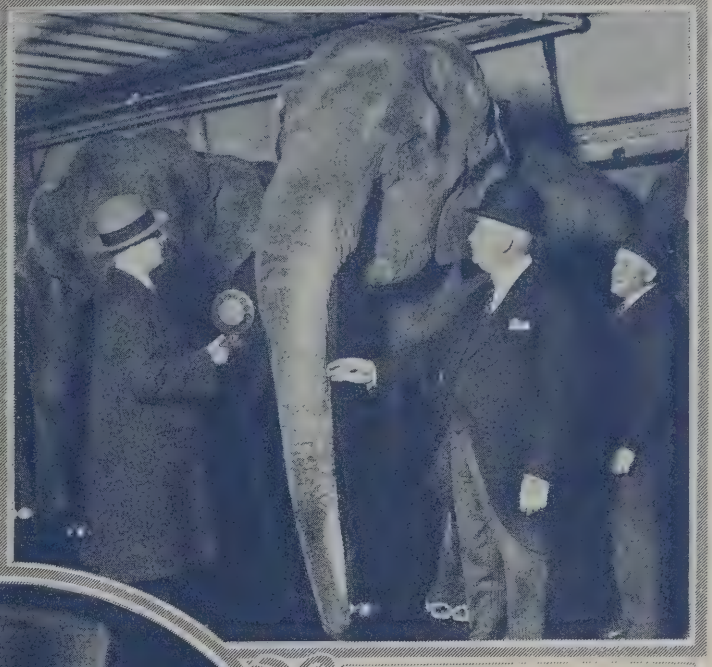
Suppose you are about to start off on a trip to Niagara Falls, by automobile, of course, and you decide to take along a radio receiver. On the way you

(*Continued on page 75*)

On a hike, tie a rock on the end of flexible wire and throw it over the limb of a tree for an aerial

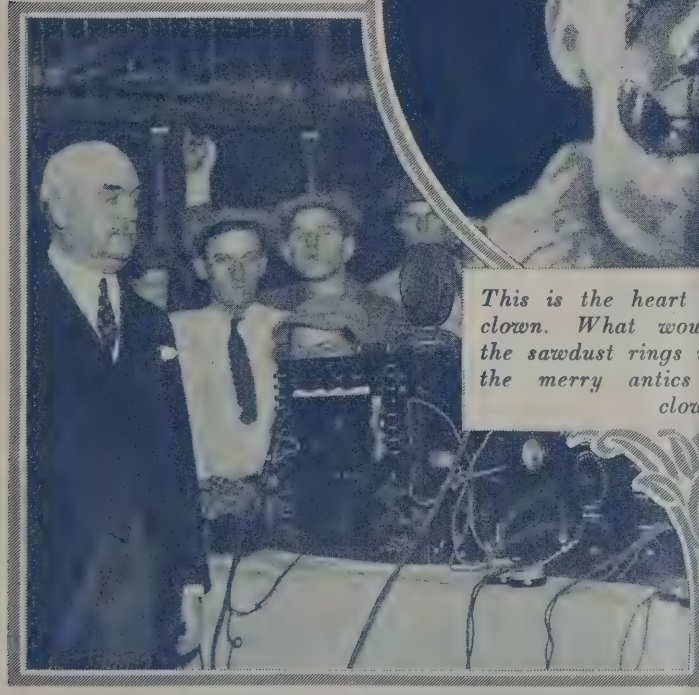
Ringling Bros. and Barnum & Bailey Broadcast

These tigers told the listeners-in on WJZ just what they thought about this sort of a "daily dozen." The lions also broadcast their ideas on circus life



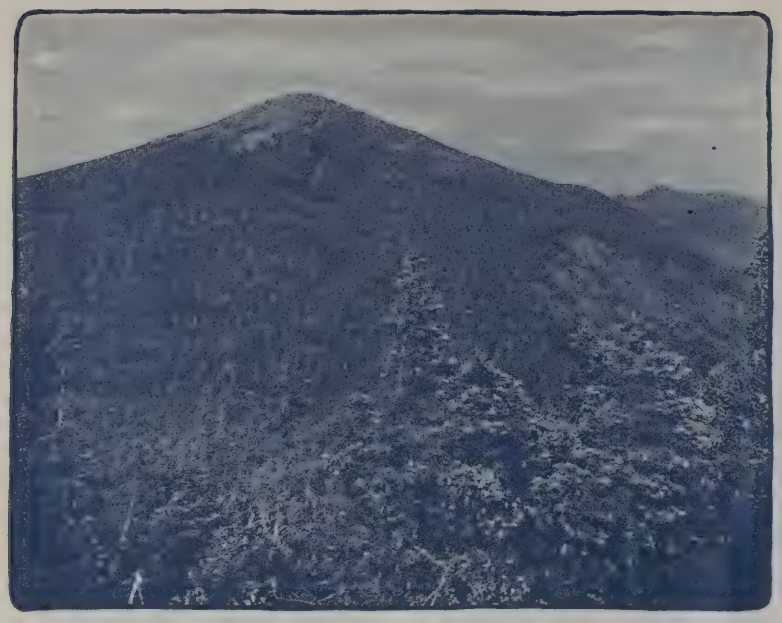
The elephants had a lot to say. After they had broadcast, the seals and the bears, the laughing hyena and many other animals of the menagerie were allowed to broadcast

This is the heart of any circus—the clown. What would we care about the sawdust rings if we couldn't have the merry antics of the acrobatic clowns?



Lew Graham, the veteran circus announcer who introduced the various animals to the radio listeners. Lew is the "officiator" during the performances of the Ringling Bros. and Barnum & Bailey circus. Thousands know his "La-dee-es and Gen-tle-men," heard again over the radio.

The Pretty Lady of the circus parade. While WJZ broadcast the circus from New York, Sells-Floto circus in Chicago was broadcast from KYW. In both, everything from the bally-hoo of the side-show announcers down to the Calliope was included



Up Above the World— A Mile High— And Radio

The first recorded ascent of Mt. Marcy, or Tahawus as it was known to the Indians, was made in 1837 by Professor Emmons and his party. There were no trails or guide posts to aid them in their endeavors, and they struggled through the virgin forests and dense alpine growth of pure scrubby balsam. Today, however, one may motor to the foot of the mountain, and the climb may be made over no less than five well marked trails which converge at or near the mountain's peak. Trails are marked and shelters have been provided. Now, more than a life's span after Professor Emmons' ascent, climbers have taken radio to the top, and any vigorous, ambitious radio fan can do the same

This story of how two hikers got radio reception on the top of Mount Marcy is told by

Hall E. Shepherd

Radio on Mount Marcy

THERE were two reasons which led Sherwood Marvin and the writer to climb Mount Marcy with a radio receiving set. The first and outstanding one was that it had never been done and thus by doing it successfully we could add a little to the short but brilliant history of radio communication. The second reason was that discoveries as to the effect of altitude and climatic conditions might be made on an antenna strung up over a mile above the mean sea level. In the former we were successful, but in the latter, due to unfavorable meteorological conditions, we did nothing. However, we successfully received a part of the programs of several broadcasting stations and so consider that the trip was a success.

Mount Marcy, or Tahawus, as it was known to the Indians, is the highest peak in New York State, rising to a height of 5,344 feet above sea level. Tahawus, or the Cloud Splitter of the Indians, was renamed after one of the leaders of the Empire State, Governor Marcy. The first recorded ascent was made by Professor Emmons in 1837, who climbed with great difficulty to the top through the virgin forests covering the lower slopes and the dense alpine growth of scrubby balsam near the top. When the first ascent was made eighty-six years ago it was a feat so difficult that the interest of the nation was aroused, but today, thanks to the work of the Conservation Commission of the State of New York, there are no less than five well defined trails, all plainly marked, leading to the top.

It had been the writer's intention to construct a single condenser Flewelling receiver, a receiver which had given splendid results at White Gate Farm, Madison, Conn., a few weeks before, on the trip to the peak of Mount Marcy, but after consulting a radio engineer who was with the Marine Corps for a year in the tropics, different plans were made in regard to the receiving set to be used. The conditions found on Mount Marcy were such that it would probably have been impossible to obtain any results whatever with the Flewelling because of its very critical grid-leak adjustment. The engineer told the writer of a very light and compact non-oscillating receiver which was a commercial product on the market and which he had tested and found to give excellent results. Thus a non-oscillating receiver was used, and such a receiver is highly recommended for the use of the camper and traveler in the wilds who desires to keep in touch with the events of the world without overloading himself with the heavy receivers now in general use.

Preparing for a test in reception at a difficult point

Now for the story of the actual ascent of Mount Marcy. Marvin and the writer left Doctors Island, located in Upper Saranac Lake, early one morning and went by boat to Bartlets Carry on the eastern shore of the lake. Packs were carried containing blankets, the necessary cooking equipment and the radio receiver already mentioned together with a hundred feet of stranded copper wire and the necessary "A" and "B" batteries. After going over the Carry we took the road and proceeded to Saranac Lake. From there we went to Lake Placid where we purchased a few supplies and then proceeded upon our way to Keene Valley Village. Many readers will remember from their school days the interesting stories by Warner of the country around Keene Valley. It was in this same district that he came so very near to being eaten by a bear. Neither of us saw a bear on the trip, although we did see several deer. From the main four corners in Keene Valley Village we took the Johns Brook Trail and headed for Marcy. This trail is the oldest and best known one from the east and was the one taken partly because of that fact, and partly because of the desire to see Keene Val-

ley. The distance to the top of Mount Marcy from Keene Valley Village is nine and one-fourth miles and the ascent 4,250 feet. After passing Bushners Falls we branched off and took

A precarious climb up the face of a rock cliff

the new trail from Johns Brook to Marcy through the notch south of Tabletop Mountain. This new trail was cut out by the Conservation Commission in 1920. We then proceeded up to a point just below the top of No Man's Mountain where we made camp for the night. The next morning we reached an intersection with the Van Hoevenburg Trail, which we took to the top of Mount Marcy. From this trail splendid views of the neighboring country were obtained.

Upon our arrival at the top the antenna was strung between two boulders on the very top of the mountain. Upon one of these boulders there is a map case erected in memory of a soldier who gave his life in the World War and one end of the hundred feet of stranded copper wire was attached to a leg of this case. For the other end a length of rope was passed around another boulder to which the antenna was attached. We had expected to have difficulty in finding an efficient ground, but found that moist soil went to the very peak of the mountain so that it was only necessary to drive down a spike. Upon checking with a compass we found that the antenna ran very nearly north and south. The lead-in was made from the southern end as there was more protection from the elements there. There was a very cold wind blowing and a driving rain fell at intervals during the day. Photographs were taken, but because of the poor light none were as good as we had hoped for. In none of them did the antenna show up, although we had hoped for a good one of the highest collector system in New York State.

In the evening the receiving set was put into operation and three broadcasting stations heard. More could probably have been logged, but it was very cold a mile up in the air and we desired to reach a valley in which to make camp for the night. The first station heard was WGY, located at Schenectady. It came in very clear and we were greatly encouraged. After getting this call the set was retuned and station WEAF, located in New York City, was heard. The next station was more difficult to reach, probably because several changes were made in the hook-up, and it was nearly a half hour before we found it to be WMAF at Dartmouth, Mass. Because it was getting late no attempt was made to receive the long wave stations as we had at first intended. We were very thankful that we had not used a regenerative receiver because, with the rain and wind, fine adjustment of the circuit would have been impossible.

On the return trip a much easier and shorter trail was used. It is known as the Van Hoevenburg Trail, the same that we intersected on the upward trip

Hanging Spear of East River Falls

at the top of No Man's Mountain, and runs to Adirondack Lodge where we found a road to North Elba. From there we went to Lake Placid and then back to Upper Saranac Lake over the same roads that we had used on the upward trip.

Although much better results might have been obtained had the climatic conditions been better, we were very well satisfied with the results obtained and were very glad to have had the opportunity of operating the first receiving set on Mount Marcy, the highest point in New York State.

The open camp at the foot of Colden

You will find

A Good Portable Receiver described on page 54

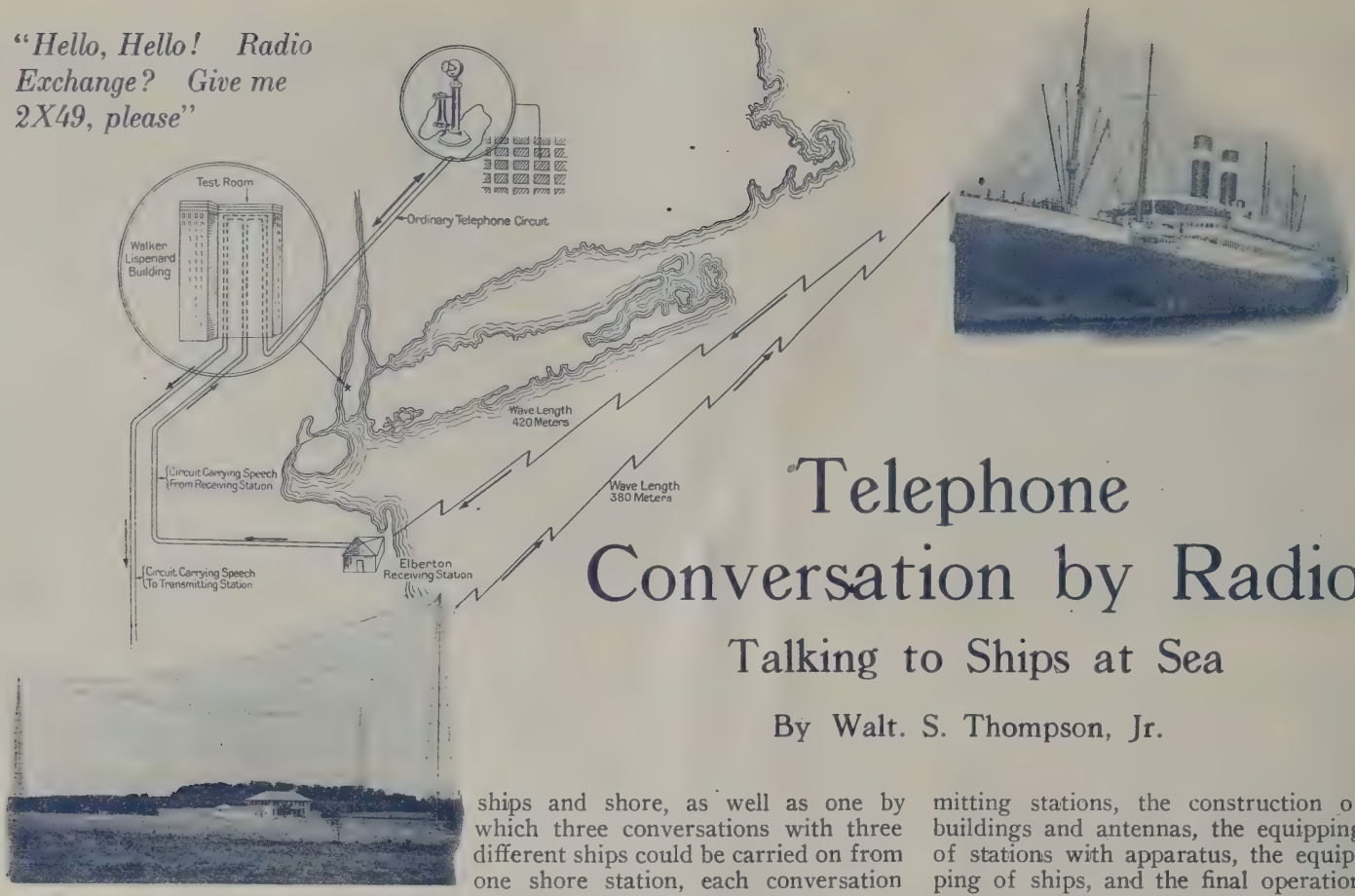
Make it and try Mount Marcy yourself!

Also,—if you are interested in Receivers—

Examine the new D-Coil Receiver

described by the designer on page 34

"Hello, Hello! Radio Exchange? Give me 2X49, please"



Telephone Conversation by Radio

Talking to Ships at Sea

By Walt. S. Thompson, Jr.

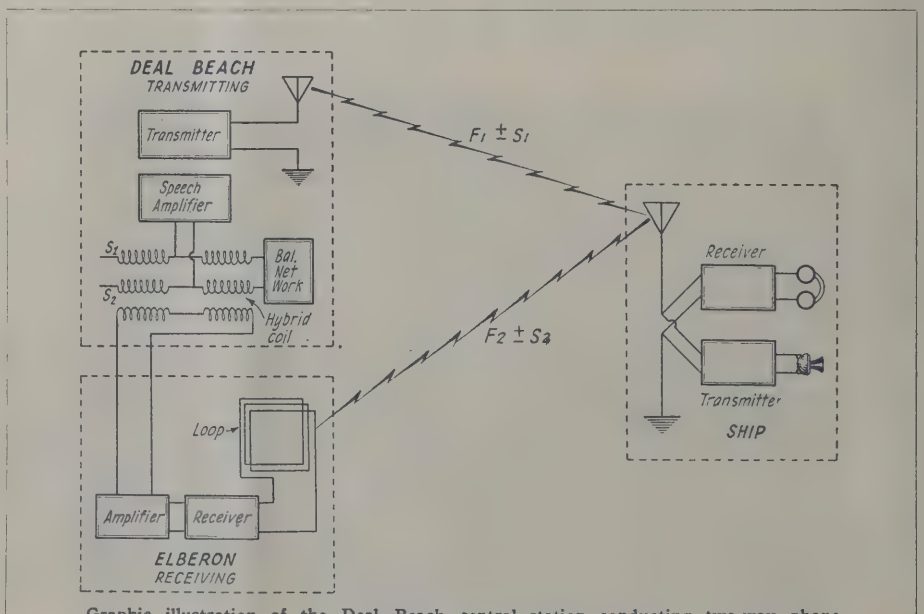
PROBABLY all the readers of this magazine are radio fans and have been enjoying the programs transmitted from the various broadcasting stations, but it is doubtful whether many of them have ever carried on a telephone conversation through the air. Although the possibility of ever using a radio system as a means for conversing with one's friends seems remote, such service will no doubt eventually be available to the majority of telephone subscribers, and will enable them to communicate by telephone with ships at sea. When this new telephone service goes into effect, the business man or any other telephone subscriber will be able to pick up his receiver and call a steamship just as he is now able to call some distant city. This service, however, will be limited to ships which are within a certain distance from shore.

It is the purpose of this article to describe very briefly the development of this radio system and to give the reader some idea of the apparatus used, as well as its operation.

This development began in 1919 when the engineers of the American Telephone and Telegraph Company and of the Western Electric Company started working on the problem of devising a means by which any telephone subscriber could talk with those on board ships at sea. This, of course, necessitated the development of a two-way radio telephone system between ships and shore, as well as one by which three conversations with three different ships could be carried on from one shore station, each conversation being independent of the other.

The engineers who designed this system were confronted with both technical and practical problems, a few of which may be mentioned as follows: The perfection of a two-way radio telephone apparatus to meet the above-mentioned requirements, the perfection of transmitting apparatus, the development of a selective receiving system which would allow the use of a narrow frequency band, the location of transmitting stations, the construction of buildings and antennas, the equipping of stations with apparatus, the equipping of ships, and the final operation and tests of the completed system.

In the completed system, two-way conversation was obtained by using different frequencies or wavelengths for sending and receiving. Because of the highly selective receiving circuits, only a small frequency difference between the two channels was necessary. In order that three conversations could be held simultaneously and independently, three separate transmitting sets and three separate antennas were used.

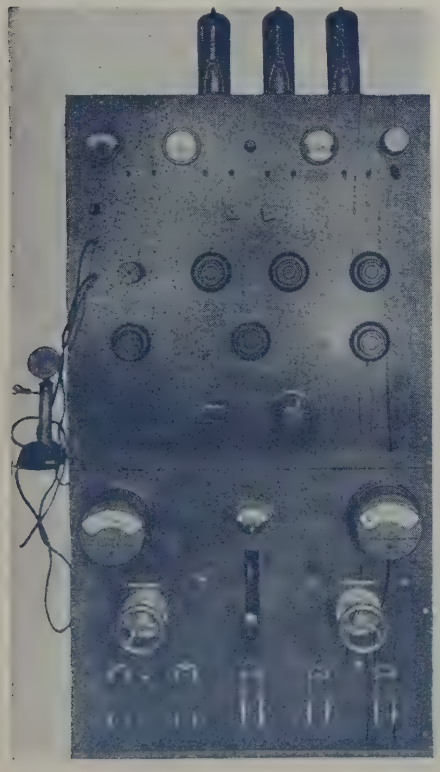


Graphic illustration of the Deal Beach central station conducting two-way phone communication with a ship at sea

After the apparatus had been developed in the laboratory, a model transmitting system of low power was set up at Cliffwood, New Jersey. With this transmitting system and receiving sets located at a distance of about sixteen miles, a thorough operating test was made. This test showed that three conversations on carrier waves of 725, 750 and 775 kilocycles per second could be separated at the receiving end without any perceptible interference between them, and that interference from other continuous wave stations was negligible.

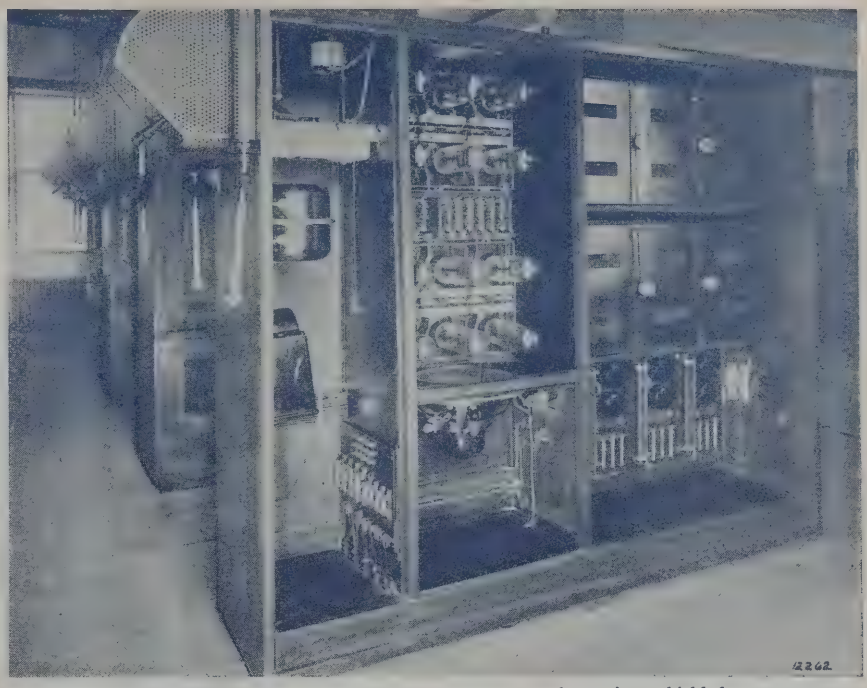
While these experiments were being carried on at Cliffwood, work was started on the permanent transmitting station at West Deal, New Jersey. The larger building shown in the picture is the permanent housing for the sets, and the smaller is used for experimental work. The three steel towers, each of which is 165 feet high, form an equilateral triangle, 500 feet to a side. Three steel cables join the tops of these towers, and three more extend inward and meet over the station. Four antennas are thus supported, one antenna going to the middle of each of the first mentioned cables and one rising vertically to the middle of the triangle.

The final system as installed at Deal Beach makes use of these four antennas and four transmitting sets, each



A transmitting unit such as installed on board ships

with a power output about equal to that of our larger broadcasting stations. One set and the vertical antenna are tuned to 600 meters for calling purposes and for emergencies. The four receiving sets with their loop antennas are located at the receiving station at Elberon, about a mile north of Deal Beach, and are connected to Deal Beach by a twenty-wire telephone cable.



One of the transmitting units. In this figure can be seen the various shielded compartments which contain the master oscillator and various amplifiers, six radio frequency power amplifier tubes, six modulator power tubes, a few choke coils, circuit breakers, etc.

The general principle of operation is indicated in the figure showing the ship station using only one antenna for both transmitting and receiving, although two different carrier frequencies are used. The dotted lines in this figure indicate the three stations, that is, one transmitter at Deal Beach, one receiver at Elberon, and one transmitter and receiver on the ship. It will be evident that the speech waves coming in from the left over the land wires will be amplified by the speech amplifier and will be impressed on the radiated radio frequency waves. The complete wave sent out by the transmitter is designated as $F_1 \pm S_1$ to indicate that the radio frequency wave with a frequency of F_1 has impressed upon it a speech frequency S_1. These waves are received at the ship which in turn sends out a radio wave designated as $F_2 \pm S_2$. This wave is picked up by the loop antenna at Elberon and is detected and amplified before it goes out on the telephone line to Deal Beach. At Deal Beach the received wave passes out over the telephone line without affecting the transmitter. The purpose of the hybrid coil and the balancing network is to prevent any received waves, coming from Elberon, from reaching the transmitter.

One operator seated at the switchboard has complete control over all the transmitting apparatus. The dials control amplification and, by means of jacks and cords, any New York long distance telephone circuit can be connected to any one of the four radio circuits.

In the final layout of the various stations, there are two operating shore stations, one at Deal Beach, New Jersey, and the other at Green Harbor, Massachusetts, and an experimental station at Cliffwood, New Jersey. The ships on which the stations were installed operate between Boston and Philadelphia or Baltimore. The diagrammatic picture shows how a connection is set up between one of these ships and a telephone subscriber. In the instance illustrated here the Deal Beach transmitting station and the Elberon receiving station are connected to New York by wire circuits, and are in communication with the steamship *America*.

Probably the most interesting experiment carried on with this apparatus was the instance in which a telephone conversation was carried on between the S. S. *Gloucester* in the Atlantic Ocean and an operator on Catalina Island in the Pacific. This circuit was made through two radio links, between the S. S. *Gloucester* and Green Harbor, Massachusetts, and between Long Beach, California, and Catalina Island, and one wire link between Green Harbor and Long Beach. The quality of transmission in this case was sufficient to enable the operators to understand each other perfectly.

In an early future number will be published an interesting European development of a radio telephone service.

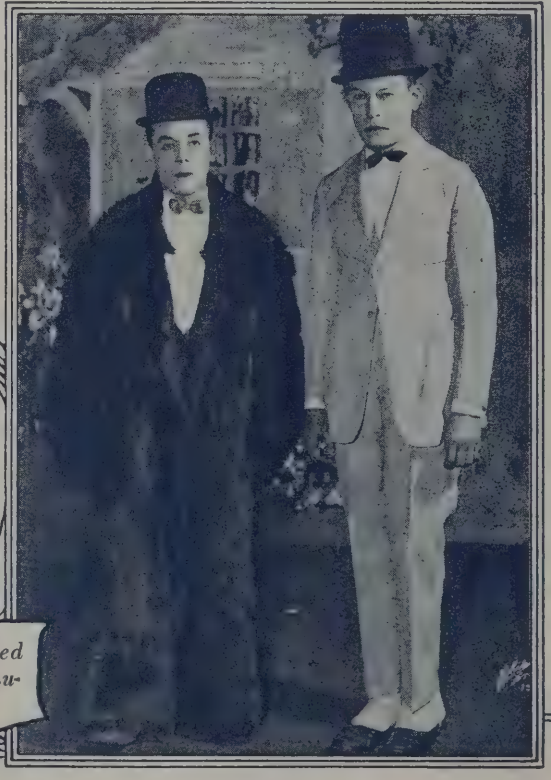
"Vogues" Broadcast

The latest Shubert success, "Vogues," broadcast direct from the Shubert Theatre by WJZ, has excellent music, good comedy and fine dancing

Odette Myrtil and Irene Delroy in a whimsical number

Anna May Dennely in "Vogues"

Betty Compton in one of her dances



Jimmy Savo and Fred Allen, the "laugh manufacturers"

Selecting Loud Speakers

The right loud speaker is one that will reproduce perfectly for the broadcast listener the concert which is being given at some broadcast station studio

By Dr. Alfred N. Goldsmith
Fellow, I. R. E., Director of Research, Radio Corporation of America

TO compress an entire orchestra into a tiny circular sheet —this is the audacious demand of the modern radio engineer when he insists that the loud speaker shall reproduce perfectly for the broadcast listener the concert which is being given at some broadcast station studio. The problem is really a comparatively recent one. While telephone receivers have been known for fifty years, they were generally adapted only to reproduce the voice feebly and with fair accuracy at best. It was necessary to press them to the ear to understand at all well, and they failed to reproduce music with any reasonable degree of satisfaction. If it was attempted to make loud speakers of them, they rattled and distorted the music badly. A new electric and acoustic technique has had to be developed to meet the requirements of an effective loud speaker. Only after considerable research and development has it become possible to produce such devices which will accurately follow their vocal masters at the broadcast studio.

A little consideration will indicate why the construction of a satisfactory loud speaker is so difficult. It must faithfully reproduce all sounds from frequencies as low as fifty vibrations or cycles per second—corresponding to the deepest tones of the organ and piano—to frequencies as high as eight or ten thousand cycles per second—corresponding to the highest overtones of the violin or piccolo and certain of the overtones of the spoken consonants "s" and "f." It must be capable of producing soft pure notes and also extremely loud notes, so that the expression and meaning of musical compositions or oratorical efforts shall not be lost. It must accurately reproduce, in correct proportion, the voice and its piano accompaniment, or the various instruments which blend into an orchestral ensemble. And, when finally produced, it must be a sightly or even ornamental article since its place is generally in the home.

Great care is taken at high-grade broadcasting stations to insure accuracy of quality in the concerts sent out from such stations. In fact, a great deal of the distortion imputed by some listeners to the station is really due to their unsuitable loud speakers. The experience is often repeated of listening to an exquisitely rendered concert from a definite station on one receiving set, only to be amazed at its poor quality on a nearby receiving set. It is for this reason that the listener should suspend judgment on the quality of a concert until he has proven beyond doubt that his receiving set is correctly designed and used, and that his loud speaker is a good example of a reliable product.

Loud speakers in general include a strong magnet, which is either a permanent steel magnet or, in a few cases, an electrically-excited magnet, which requires battery current for its functioning. There is also a coil of wire, generally wound over the permanent magnets, through which flow the electric currents, which carry the music in the form of regular or irregular fluctuations of these currents. In some loud speakers, an iron diaphragm is set into motion by the variation of magnetism caused by the incoming electrical currents carrying the music. In others, diaphragms of mica or other materials are set into motion by mechanical systems attached to them, which, in turn, are controlled by the varying magnetic pulls on a steel or iron movable part of the system. The exact arrangement of the loud speaker is therefore not yet standardized, but what is required from the loud speaker is well-known to the experts; and elaborate electro-acoustic laboratories have been established by the leading radio companies for the continued development and improvement of the device.

Practically all loud speakers are provided with a horn of wood, fiber, papier-mâché, or some other material which is believed to be suitable. A great deal of the quality and sensitiveness of the loud speaker depends on the materials, shape, and mode of attachment of the horn. As a general rule, short horns emphasize the higher pitched notes. However, so much depends on the angle of the horn opening and on its method of attachment, together with the characteristics of the telephone receiver portion of the loud speaker, that no general statements can be here given as guides to what constitutes a suitable horn.

In the development of the new Radiola loud speakers which have been designed as the result of much systematic laboratory experimentation literally thousands of accurate measurements have been made to avoid the common faults of most loud speakers. Unfortunately the testing procedure and laboratory arrangements are too technical and complicated to be described here, but they represent a most interesting modern development in the field of sound reproduction.

The principal faults of some loud speakers, and the general listening tests for them are:

1. The loud speaker fails to reproduce high pitched notes, but does respond to low pitched notes. Such loud speakers will sound well on piano pieces in the lower register, and on bass voices. Tenors and sopranos will sound thin and weak, and the violin will lack piquant quality, being "flattened out" into flute quality. Speech, and particularly feminine speech, will not be fully intelligible. Orchestral

(*Continued on page 63*)

The D-Coil receiver is seen resting on the top of a console victrola. The output of the receiver is connected to a phonograph attachment which is attached to the victrola. The panel of the receiver is mahogany colored and all the dials are of the same color. The cabinet has a veneer of dark brown leather over the wood and since the victrola is mahogany, the whole setting blends in very nicely

The D-Coil Receiver

A Wonderful Circuit—Designed on a New Principle

A New Type of Transformer Provides a Stable Non-Oscillating Radio Frequency Amplifier—Covers a Wide Range of Wavelengths—Outdoor or Indoor or No Antenna—Easy to Construct—Simple to Tune

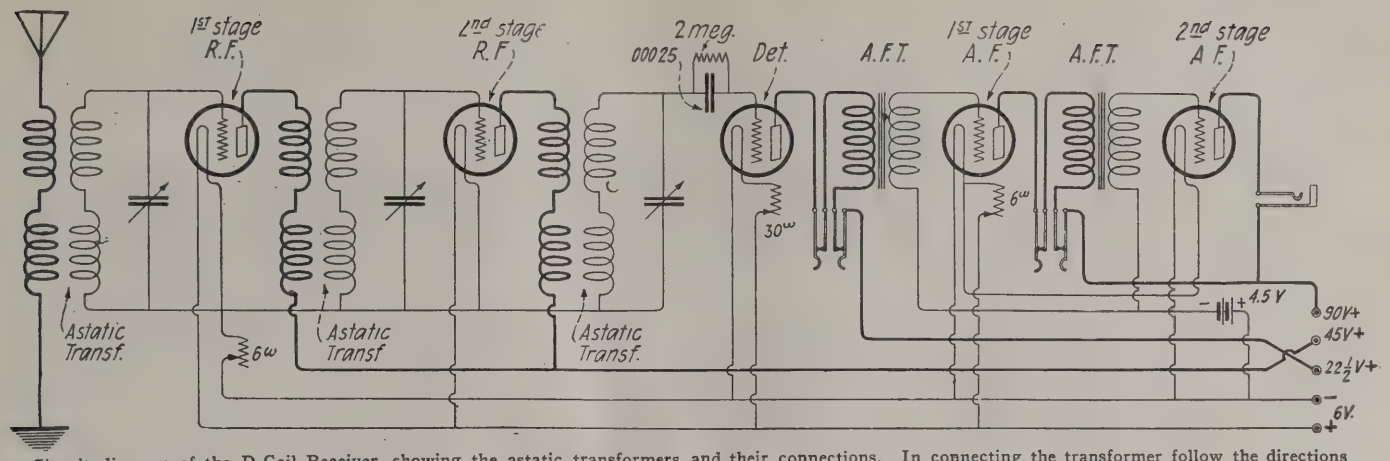
By K. M. MacIlvain

THE limitation in a radio receiving set employing several stages of radio frequency amplification is that the tubes in the radio frequency stages tend to oscillate due to the back coupling in the different radio-frequency circuits. The greater the number of tubes used for radio-frequency amplification the greater is the tendency for these tubes to oscillate and there is a definite limit to the number of tubes that may be used in any of the standard circuits published up to date.

The following is the description of the construction of a receiver that uses special coils or transformers in the radio-frequency circuits which so stabilize the circuits that, using the number of tubes shown in the accompanying circuit diagram, there is not the slightest tendency for self oscillations, and therefore the maximum amplification possible with the number of tubes shown can be obtained, as each radio-frequency circuit may be tuned right on the peak of the incoming wave without the usual howling and subsequent loss of intensity experienced in the majority of radio-frequency amplifying circuits. Many circuits employ a resistance in the circuit to damp out the oscillations and the loss thus introduced is probably so great that it would be possible to cut out one tube to eliminate the damping resistance and still get the same volume in the output circuit.

The neutrodyne receiver uses neutralizing condensers to balance out the back coupling, due to the capacity feed back in the elements of the tubes. But this does not neutralize the feed back due to the coupling between the inductance coils in the different circuits, and many B. C. L.'s who have constructed their own neutrodyne receivers find it exceedingly difficult to neutralize their sets properly, due to the fact that these neutralizing condensers will not balance out the feed back due to the coupling between the coils. The radio experts say that the coils in the neutrodyne receiver when placed at just the right angle may be got into a small space and at the same time have zero coupling. That angle is a critical angle and for the amateur building his own receiver it is a mighty hard one to find.

The D-Coil or astatic receiver is an advance over most modern circuits, as it employs no neutralizing condensers and no damping resistance, and principally it is better because the radio-frequency amplification can be carried to a higher degree. In other words, more stages of radio-frequency amplification can be used and consequently greater distance and more volume may be obtained. This seems perfectly reasonable to expect, since there is no tendency to oscillate with the number of tubes used in the circuit that is herein described. The amplification can be carried along further to a point where oscillations



Circuit diagram of the D-Coil Receiver, showing the astatic transformers and their connections. In connecting the transformer follow the directions carefully as given in the text. Reversing one connection will render the set inoperative

will commence and when this point is reached, some neutralizing unit may be employed and the amplification carried still further.

The heart of the astatic receiver circuit is in the radio-frequency transformers which are wound in a special manner so that the magnetic field around them is neutralized and there is therefore no coupling from one coil to another. Due to the fact that these transformers have a neutralized field they may be located in the receiver assembly in a vertical position, and it is not necessary to spend a lot of time in setting them at some critical angle as is necessary with the coils or neutroformers used at the present time in the standard circuits. There will be zero coupling between these transformers when aligned in a vertical position. In the test circuit which the author built these coils were set a distance apart just great enough to mount a tube socket between them. Since these coils are the heart of the circuit it is essential, at this point, that their construction be described in detail.

CONSTRUCTION OF TRANSFORMERS

First, procure three pieces of bakelite tubing, three inches long and three inches in diameter. With a hack saw, cut a ¼-inch slot down the side of each tube, starting at one end and cutting to within ¾ of an inch of the other end. Also, on each tube, cut a similar slot on the opposite side, diametrically opposite as shown in the diagrams. Obviously, it wouldn't be advisable to cut straight through from one end to the other as the tubing would then be in two sections, therefore the ¾-inch spacing is left at one end to make the tube self-supporting. The windings consist of a primary and a secondary wound with No. 24 double cotton-covered copper wire. There are 10 turns in the primary winding and 40 turns in the secondary. Four binding posts for the terminal connections to the two windings are mounted at one end of the tube as shown in figures 2 and 3. Two for the primary winding are mounted at the bottom of section (A) and two for the secondary at the bottom of section (B). For the purpose of discussion these are numbered 1, 2, 3 and 4, respectively. Good serviceable binding posts may be made from ⅝-inch 8/32 round head brass machine screws with nuts and washers to fit.

Now start the winding. Cut off a piece of No. 24 D. C. C. wire about 14 feet long. This will be long enough for the primary winding with a good surplus for connections to the binding posts. Connect one end of this wire to the binding post marked No. 2 in figure (2), and connect the end of the wire left on the spool to the binding post marked No. 3 in the figure. Since

LIST OF PARTS

One 7"x26" Box
One 7"x26" Radion Panel
One 7"x25" Base board
Five Paragon sockets
One 30-ohm rheostat
Two 6-ohm rheostats
Three 43-plate Cardwell condensers
Two Acme audio frequency transformers
Three pieces of bakelite tubing 3" long
One filament switch
Three 4" dials

ACCESSORIES

Five UV-201A tubes
One 6-volt, 100-amp. hr. storage battery
Four 22½-volt batteries
One loud speaker
One plug
One pair of phones
One aerial with accessories

This picture shows the proper arrangements of the various instruments. The layout provides short connecting leads and easy assembly. A 4½-volt "C" battery is shown on top of the first audio frequency transformer (from right to left)

binding posts 1 and 2 are the primary winding terminals, and since binding posts 3 and 4 are the secondary winding terminals, we thus have the beginning of both windings, with the two wires connected to terminals 2 and 3 as described above. Starting with the wire attached to terminal No. 2, wind in a counter-clockwise direction until you come to the slot, marked (x) in figure 2. Pass the wire through this slot and out through the slot on the other side of the tube, marked (y) in figure 2. Now continue in a clockwise direction past binding post 4, and when you come to binding post No. 3, pick up the beginning of the secondary winding and wind it in parallel with the primary winding, both wires side by side. Continue the double winding until you come to the slot (x), pass the wires through this side and out the other side at (y), proceeding with the winding in a counter-clockwise direction on this side. When ten turns have been wound on, drill a small hole in the tube at the tenth turn and in line with binding post No. 1. Pass the end of the wire being used for the primary winding through this hole and connect it to binding post No. 1.

One complete turn, starting at terminal No. 2, for instance, is traced in a counter-clockwise direction to slot (x), through the center of the tube and out at slot (y), in a clockwise direction past terminals 4 and 3, through the slot at (x), out at (y) and in a counter-clockwise direction back to the starting point. The primary winding having been thus completed, continue on with the secondary winding until 40 turns have been wound on. Drill a small hole in the tube at the 40th turn and in line with binding post No. 4 and connect the end of the secondary winding to this terminal. One astatic transformer is thus completed and two more are wound in a similar fashion. Two hundred feet of No. 24 double cotton-covered copper wire will be enough for all three transformers and there will be a surplus.

Just a few lines to explain why these transformers are so efficient in the circuit in which they are used. The following theory will explain why they have a neutralized field and thus afford no chance for back coupling between the coils. Looking at figure 4 and assuming a current flowing in the secondary winding due to signal current flowing in the primary, as the current flows through that section of the winding marked (A) it will produce a magnetic field which will be in the direction as shown by the line and arrows on that side. The same current flowing through the section marked (B) will set up a magnetic field in the opposite direction as shown by the arrows, since the current through this section of the winding is in the opposite direction from that in which it flows through the wire in section (A). These magnetic fields will be equal since they are produced by the same current flowing through the same number of turns and they will be opposite and thus tend to neutralize. The resultant field, then, if any, will be very small.

THE CIRCUIT

The schematic diagram of the astatic receiver is shown in figure 1. The

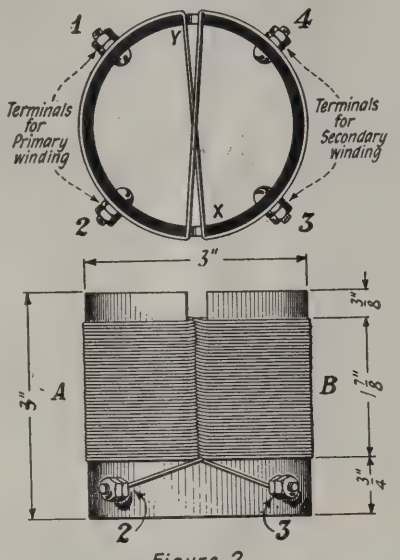


Figure 2

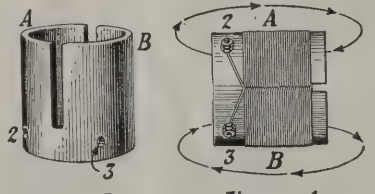


Figure 3 Figure 4

These sketches illustrate the method of winding the D-coils described in the text

first two tubes are radio-frequency amplifiers, the third is the detector and the last two are the audio amplifiers. UV-201A tubes may be used throughout, or they may be used only for amplifiers and a UV-200 tube used as a detector. The filaments of the radio-frequency amplifiers are controlled by means of the 6-ohm rheostat shown in the figure and connected as shown. Six ohms is sufficient to control these two tubes connected in parallel. The detector tube is controlled by a single rheostat and if a UV-200 is used for a detector the resistance of this rheostat should be 6 ohms, but if a UV-201A is used this should be a 30-ohm rheostat. The two audio amplifiers are controlled by the single 6-ohm rheostat shown in the figure. The antenna circuit is untuned. One terminal of the primary winding of the first astatic transformer is connected to the antenna and the other terminal of this winding is connected to the ground. The ground is tied through to the grid-return of the first three tubes and to the negative filament terminal of the first two tubes.

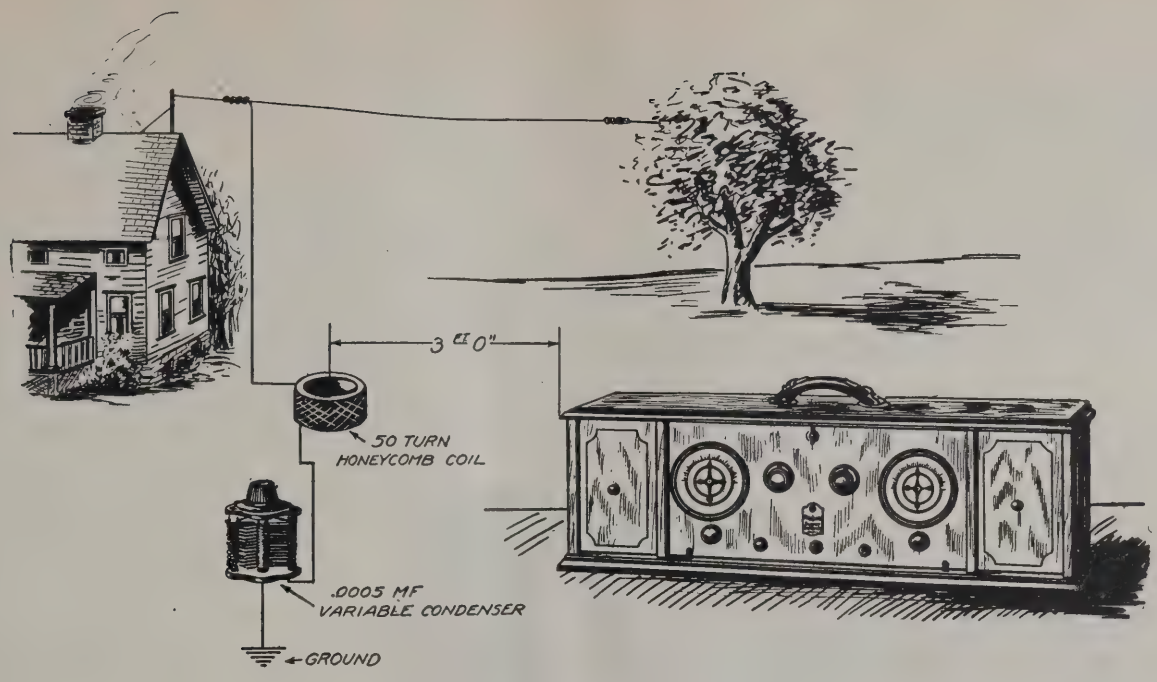
The antenna circuit simply functions as an untuned pick-up circuit for radio-frequency energy and this energy is passed on to the grid circuit of the first radio-frequency amplifier by means of the coupling between the 10-turn primary and 40-turn secondary of the first astatic transformer. The transformer is so designed as to provide the transfer of a great amount of energy between the antenna circuit and the first amplifier circuit. The secondary of this transformer is tuned by means of the 43-plate variable condenser connected directly across the terminals of this winding. A variation of this condenser from minimum to maximum tunes in stations between 100 meters and 650 meters in wavelength. Thus everything from amateurs, through the broadcast range and up to the commercial ship and shore stations can be tuned in on this combination.

The plate of the first radio-frequency amplifier tube is connected to the 45-volt tap of the "B" battery through the primary winding of the second astatic transformer. The secondary of this transformer is tuned in the same way as the first and the amplified energy applied to the grid of the second tube. The plate circuit of the second amplifier tube is a duplicate of the first. The secondary of the third astatic transformer is in the detector circuit and is tuned in a similar manner to the first two and the energy applied to the grid of the detector tube through a .00025 mfd. condenser and a 2-megohm grid leak.

There is a double circuit jack in the plate circuit of the detector tube which is wired up as shown in figure 1. If the phones are plugged in here, the circuit to both sides of the primary winding of the first audio frequency transformer is opened and the plate circuit of the detector tube is completed through the phones. When the phone plug is removed, the primary winding of the audio frequency transformer is connected in series with the plate instead of the phones and the audio frequency energy is passed on to the grid of the first audio frequency amplifying tube. The plate circuit of this tube is a duplicate of the detector tube plate circuit with the exception that it is tied on to the 90-volt tap of the "B" battery, whereas he detector tube plate was tied on to the 22½-volt tap.

If a 201A tube is used as a detector the plate voltage may be increased to 40 volts, although there is little difference in the volume obtained and there-

(*Continued on page 74*)



Increasing the Range of Your Super-Heterodyne

By William J. Smith

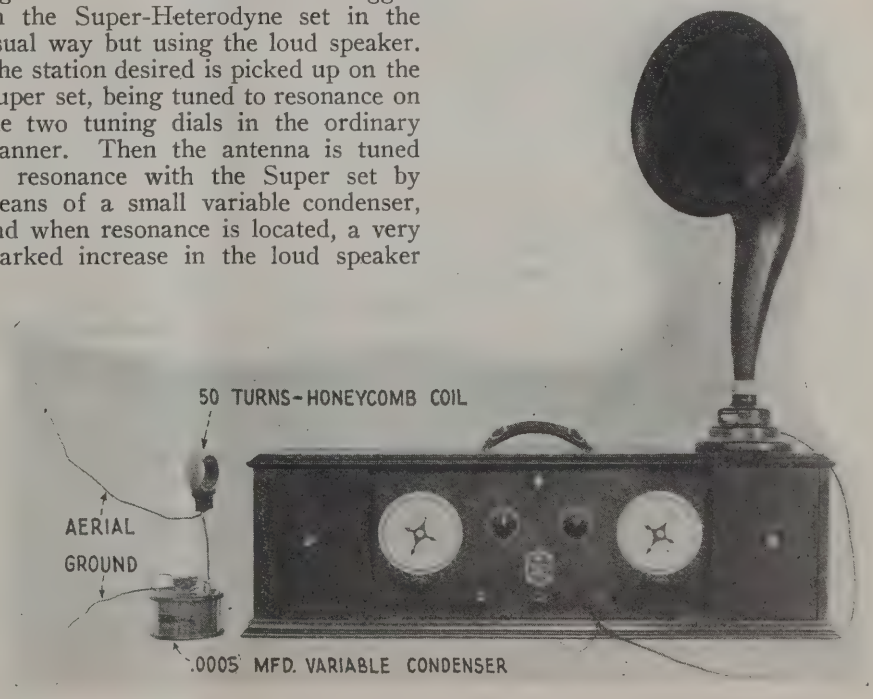
THAT type of Radiola Super-Heterodyne which is equipped with a small self-contained loop provides a greater range of reception than any type of radio receiver which the writer has ever witnessed in operation with a loop of such small dimensions. In the Eastern part of the United States one is enabled with this compact outfit often to secure loud speaker operation from stations as far West as Denver, Colo., and further.

By the use of an enlarged external loop, consisting of fifteen turns of wire spaced three-quarters of an inch apart and wound on a rectangular frame (14½ inches in width, 10½ inches in depth and 25 inches in height), it was easily possible to obtain loud speaker operation from the Pacific Coast with quite some regularity, even when a local broadcasting station only three-quarters of a mile away was in operation, and with a difference in wavelength of only 9 meters.

In event that the owner of one of these splendid equipments is not in a position to construct a loop of the dimensions which I have set down above, the receiving range of the semi-portable Super-Heterodyne can be materially increased by the method shown in Figure 1, where a small honeycomb coil of approximately fifty turns and a variable condenser are connected in series with the usual type of aerial. When the honeycomb coil is placed parallel with the loop inside of the Super-Heterodyne box, and the antenna, as well as the Super-Heterodyne set, are tuned to resonance with one another and to the frequency of the incoming signal, then a marked increase in signals will result; in fact, so much so that it is usually necessary to decrease the sensitiveness of the Super-Heterodyne for quieter operation. It will be found that an increase in signals can be obtained even though the honeycomb coil is three or four feet distant from the loop of the Super set.

In general, the process of tuning which I usually employ is the following. Distant stations are first logged on the Super-Heterodyne set in the usual way but using the loud speaker. The station desired is picked up on the Super set, being tuned to resonance on the two tuning dials in the ordinary manner. Then the antenna is tuned to resonance with the Super set by means of a small variable condenser, and when resonance is located, a very marked increase in the loud speaker volume will result. I recommend this connection to those who have not had the opportunity to construct a larger loop for the Super-Heterodyne receiver.

I have not yet found it necessary to use a headphone with the Super-Heterodyne set to locate a far distant station, as the sensitiveness of this receiver is such that it will invariably operate the loud speaker satisfactorily.



Boys!
Gather 'round!

The Boy Scouts of America

What Radio owes to them and what they owe to Radio

By Pierre Boucheron

A pioneer in the Radio Industry
Tells how the Boy Scouts and Radio hit it off together

Members of the Boy Scouts of America made tests for "dead areas" in Central Park with a portable radio set, and acquired useful data for future experimenting

IT is a long way back to those days of Greece, in which the romantic figure of the Marathon runner was the sole means of communication between the cities of this early democracy.

The classic story of the runner Phidipides, who bore the news of the Greek victory of Marathon for a distance of some twenty odd miles, then to drop dead from sheer exhaustion, is a story that stimulates boys and men alike to an appreciation of the unswerving purpose and tenacity of this man to perform the task given him though it cost him his life.

Great strides have been made in the science of communication since that time. Today the boys of our Nation are spared from such undertakings, for electricity has become the standard message bearer the world over. First, science gave to mankind the telegraph, then the telephone, and now radio is ready to serve every man, woman and child.

Radio enjoys the distinction, perhaps as no other art, of being especially a boy's and young man's game. As a matter of fact, the great progress that radio has made during the past five years can be directly attributed to the imagination and energy of boys, who began to experiment with radio shortly after Marconi's first successful tests back in 1920.

It was the after-school experimentations of Edwin H. Armstrong that gave to radio that famous device we call the regenerative circuit—a circuit that jointly with the vacuum tube has done more to bring the broadcasting art to its present state of usefulness than any other single invention.

Of the men who are leaders in radio today, whether in the long distance radio telegraph, marine or broadcasting fields, there is hardly one who did not start his career as a boy experimenter between the ages of 14 and 19.

Today there are in round numbers about 500,000 Boy Scouts in America. Probably three out of every four Boy Scouts has made or owns a radio set. With such a display of intense interest in the art, the future has surely many wonderful inventions and developments in store for us. With thousands of boys experimenting, playing and studying radio,—growing up with the

BOYHOOD LEADS TO RADIO

The Beginning of a Career

As told specially
for Boy Scouts

By Pierre Boucheron

I will tell you how I entered the radio profession.

First I learned the American Morse code jointly with a boy friend back in 1906. We strung a wire between our houses about two city blocks apart, then we made our own telegraph instruments, winding the electro magneto by hand. The line was the closed circuit method and worked quite well with bluestone batteries. Every morning and night we "spoke" to each other for a brief spell by means of dots and dashes. In three months we were proficient enough in telegraphy to be able to converse quite clearly and rapidly and three months later reached the speed of 25 words a minute. Frequently we spent some of our spare moments with the agent and operator of the nearby railroad station who permitted us to occasionally send and receive a real telegraph message over the regular railway telegraph circuit. Later I obtained a summer job in a telegraph office during the school vacation period. I don't recall ever having spent a more enjoyable vacation while at the same time earning money which came in good stead when school started again in the Fall.

Then in 1907 came radio amateurism. There were about seven amateurs in New York City then. How proud I was to be one of them!

In August, 1912, I sailed away on a big freight ship as wireless operator and in the succeeding four years I saw every important part of the world. But best of all was the experience that thousands of others like myself obtained out of the War by enlisting as wireless operator in either the Army or Navy.

business, as it were,—there is now building up a reserve of talent that will make our present prophecies of radio movies, radio vision, radio transmission of power, etc., pale into insignificant child's play.

Radio, of course, is not the special plaything of any set or group of boys. In point of cost it is easily within the reach of every wide-awake boy in the country. A resourceful boy of 14 tells me he has built himself a complete crystal receiving set at a total cost of one dollar. Another boy of sixteen with more well-to-do parents has bought himself a complete vacuum tube receiver at a cost of $100. I feel quite certain that the fun and fascination these two boys enjoyed has been the same in each case.

Although radio is within the reach of every boy, it is particularly accessible to Boy Scouts because of the splendid organization behind them.

Every Boy Scout should learn radio principles; should experiment and tinker with electricity, and should learn the telegraph code. Many of America's successful men started their careers as telegraphers; among them Andrew Carnegie, Thomas A. Edison, Frank Munsey, General J. G. Harbord and David Sarnoff. Something like 75 per cent. of all railroad presidents were at one time telegraph operators.

Boy Scouts should learn the telegraphic code for two prime reasons, which are as follows:

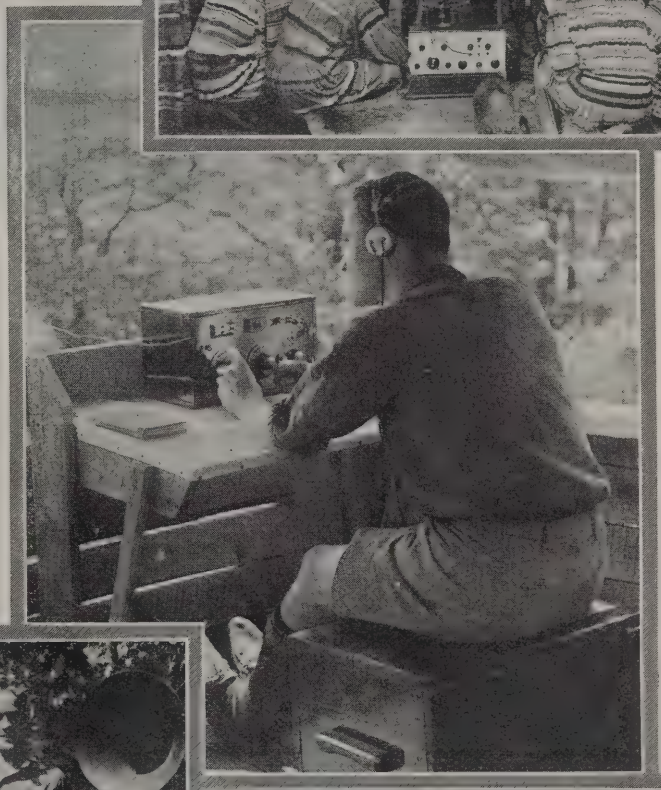
First, because this knowledge and ability will make one a better Scout, of greater use to his troop, and if a certain proficiency is attained, will qualify him for the Scout Radio Merit Badge.

Second, it will train the ear to an unusual degree of alertness and this newly acquired ability may later become a stepping stone to a future profession either in telegraphy, radio or cable operation.

In Scout work there is a great deal of fun to be had in signaling when several in each troop are sufficiently speedy in sending and receiving telegraphic messages; say from ten words a minute and upward. The apparatus is simple and may consist of two spark coil transmitters, two one-tube portable receivers and two portable aerials in the inexpensive form of two coils of copper wires. Two units of the troop can then separate by distances of from one-quarter mile to one mile, and then exchange messages. All transmitting apparatus of this nature must be licensed by the Department of Commerce.

Learning the telegraph code is not very difficult. First you memorize the alphabet consisting of dots and dashes. There are two codes used today: the American Morse Code, for land line wire work such as commercial telegraphy, railroad, news and stock broker communication; the Continental Morse for cable and radio communication. While it is advisable to become adept in the use of both codes, I recommend learning the Continental Morse Code, as this is the code used exclusively in radio work. One should first memorize the dots and dashes of the Continental Code so each character can be ticked off with a pencil or coin on a table or other hard surface. It takes on an average an hour to memorize the characters. It is much easier to attain speed in sending the code than it is to receive it. The latter requires consistent application for several weeks. A scout who determines to learn the code should get together with a nearby friend and practice each day for at least an hour. After a short time he will be able to understand the now meaningless dots and dashes, especially the messages exchanged between amateur stations that usually operate on 200 meters.

And now we come to what this ability may lead to. When a Scout is older and has left school, he can take up any one of a number of well-paid professions that require proficiency in sending and receiving telegraph messages. A few of these positions, as they occur to me, are: (*Continued on page 75*)



Boy scouts all over the country use radio. The upper picture shows a Boy Scout troop introducing the mysteries of radio to Seminole Indians near Miami, Florida. Just below a Scout of Queens Council in his tent in Camp Matinecock at Bear Mountain is seen tuning in the New York City stations Here to the left a Boy Scout of Waxahachie, Texas, is proudly exhibiting the set which he has installed in camp.

The Scout with the overseas cap is enjoying his radio set in Camp Wayne, in Ohio

Radio in the Canadian Wilderness

Our adventures over the portages and down the crest of White Water

By Sinclair Arthur

DR. HOBART and I decided to take our vacation in the Canadian wilderness. The idea appealed to us. The wilderness, where men imagine they are men.

We did think enough of our tame civilization, however, to include a good, portable radio set in our equipment.

On the way up to Chicoutimi we learned that a trip into the interior of Labrador, entailed something of an exact science; namely, the science of economy. Our kindly adviser—who, by the way, happened to be the mayor of Chicoutimi—told us that one simply doesn't carry excess baggage. He explained in detail:

A canoe, of course, would be necessary since travel of any extent during the summer months could only be effected by water. One blanket for each individual would be required. Clothing should consist of no more than light felt boots, khaki trousers, heavy flannel shirt, felt hat and heavy underwear.

A rain coat would be superfluous since one would undoubtedly perspire enough to warrant a soaking now and then.

A pot for tea and a pan for the foods would suffice as cooking utensils.

A tent for the guides and a tent for us would serve as shelter. One gun, a hatchet and a heavy jack-knife would complete the essentials.

"Of course," the mayor concluded as he shrugged his shoulders, "you will probably carry liquid refreshments, but you'll regret it on the portages."

Our guides, a French-Canadian and an Indian, protested vigorously when they learned that we contemplated the inclusion of our radio in the equipment. It was certainly apparent that every ounce would count.

We had a thirty-five-mile drive north of Chicoutimi to the head of Clear Lake. Most of the road consisted of logs laid cross-wise in the trail. Large holes and occasional stumps marked the course. The French-Canadian, Jacques, demonstrated his skill as a chauffeur by trying to leap over most of the pits and jump over the tree stumps and rocks.

Our guides. The Indian, Joe, on the left, the French-Canadian, Jacques, on the right

The supplies and equipment were loaded in the canoe. Doc and I sat in the middle, and the Indian, Joe, kneeled in the prow. Jacques occupied the stern.

Everybody in the camp came down to the shore to wish us luck—and lots of it. Jacques gave the word, and with that, he and Joe swung the canoe out into the water with short, powerful strokes. All woodsmen in Canada are proud of their paddling skill, and their strength. Jacques and Joe put their soul into that exhibition. Away out into the lake they paddled, never faltering, never relaxing a stroke.

Across the lake and down the Shipshaw we glided. The immenseness of country seemed to enfold us, gently at first, then seeming to close behind us, and finally we could feel the pull of the North. We could almost sense the fear that all natives of that wilderness learn to know at an early age.

Every family out in that vast wilderness has lost a friend or relative who has strayed too far from the trails—and never come back. The little villages are clearings. Not a tree within the forest line. The people are afraid of the forest. They do not want trees in their yards, in the streets, or in the town.

Doc suggested that we get out the radio.

"Be yourself, Doc," I chided. "Jacques made us leave the set in Chicoutimi."

But Dr. Hobart had been a professional man for a long time. "These Canadians," he replied, "have reconciled themselves to the idea of visitors from the States coming here to enjoy the freedom of the trails, and incidentally, to escape from a remarkable amendment in the Constitution—the eighteenth, I believe."

"Yes?" I encouraged.

"So," he finished, "I put the radio in a wooden box, marked 'Johnny Walker.'"

However, we had very poor results without an aerial. The guides sniffed.

Toward evening we landed, and prepared for a two-mile portage. Each one of us had to carry a big load as it would not be practicable to return for any part of our equipment.

The land rose up to a high ridge that we had to cross. Bending low under our burdens, which we held on our shoulders, a strap hooked to the baggage and passing around our foreheads, we stumbled over rocks and bushes, clutching at boulders, or saplings, or any object that might offer a means to pull us up the incline.

Gnats and small, black flies gathered around our heads in black swarms. They flew into our eyes, crept into our

The camp at the head of Clear Lake

nostrils and ears and crawled down our necks. We began to realize the tortures of a portage. The need for economizing in equipment was obvious.

Halfway up, Dr. Hobart's load caught on a low branch, pulling him back on his heels. He struggled for a moment, clutching at the air. And then he toppled over.

"Be yourself, Doc!" I yelled.

"Shut up!" he growled.

The laugh froze within me. The radio was in his pack!

Over the ridge, we stopped to rest. Below us was a great dam under construction. The workmen's camp lay at the edge of a clearing that somehow reminded me of a circus. It certainly seemed out of place. A great wall of concrete towered above — reached above the tree tops. At the furthest end steel rods projected from wood palings. Derricks swung huge iron mats over the heads of workmen and dropped them into place. A tremendous activity covered the ground for acres around. But the scene appeared to be a miniature puppet show. The tiny figures appeared to be occupied with senseless, futile tasks, lost in the vast wilderness that seemed to smother the puny efforts of man.

The foreman told us that British interests were building a dam that would require eight more years for completion. When finished, he informed us, it would furnish enough electric power for the North American Continent. The builders forbid any publicity because they feared opposition would result should the Canadians learn of the extent to which the dam would inundate the surrounding country with water.

That evening we entertained the men of the camp with our radio. They offered to take up a collection for the set if we would sell it. Upon refusal, however, we were oath-bound to send them a good one when we reached civilization again.

By six the next morning, our little party was loaded into the canoe, and our journey down the "White Water" commenced.

Dr. Hobart trying to cook a strip of bacon on the end of a forked stick. He couldn't accomplish the feat satisfactorily. This is where we made camp at the mouth of White Water

In Canada there are many unnamed rivers called "White Water" because the water flows between high cliffs at a terrific rate, whipping the center into foam.

Jacques informed us that we would travel that day without stopping (if luck was with us) until late at night. Not only that, but we would also travel in the exact center of "White Water" or lose our equipment as well as our precious persons.

The canoe was launched. The black, swirling water caught the craft with a jerk. A few swift strokes of the paddles projected us into the foam. A sickening lurch threw us around, and head on into the spray we hurtled at a furious speed.

We seemed to be riding higher than the shore water. Conversation was impossible most of the time. Occasionally Joe, the Indian, would lean forward, point his paddle, and then, with a yell, plunge it into the water, elbow deep. The canoe would shoot around a boulder. Jacques would pull our craft around into its course with a deft twist of his paddle in the stern. And again we would plunge and leap down the "White Water."

All day we rode the crest, every minute a hair-raising experience. Long into the evening we kept on our course.

A steady, high-pitched swishing sound caught my attention. It grew louder. The noise resembled escaping steam. I leaned back to ask Jacques what it was. He nodded his head indicating that I should look forward. I did.

A solid mass of white loomed up. The river ahead was seething foam, boiling over rocks, spurting up from the cliffs at each side, rolling back over itself in licking tongues of black water flecked with white.

I grabbed Dr. Hobart. The next instant I was blinded with spray. Water poured over my head. I gasped. The canoe keeled over, jerked to the left, skidded, then swung to the right. A deafening roar lulled my senses. A crash—water—more water—

We glided along evenly. I opened my eyes. Joe was laughing.

"All right, boys!" Jacques cried from the stern. "We rode the rapids and only lost a paddle."

The shore line sloped down to the lake ahead. We pulled over to the bank, fastened the canoe, and jumped ashore to stretch our cramped legs.

While Dr. Hobart and I examined the radio, the guides put up camp. It was 10:00 P. M. by my watch. The sun had just set, and darkness had begun to settle over the still forest.

Never in my life have I enjoyed a radio set as I did that night. The four of us lounging around the camp fire listening in on the organ prelude, "Adagio," from First Organ Sonata by Mendelsohn, broadcast from WGY, our silhouettes thrown out into the dark amphitheatre that lay below the interlocking branches of the trees, reminded me of many Arabian Nights' tales of magic boxes working their wonders in the enchanted forests.

(*Continued on page* 78)

Looking across Pike Lake from the Indian camp. Something of the immenseness of the Canadian Wilderness can be detected here

The Right and Wrong of Receiver Tuning

How to Prove That You Are Right and the Other Fellow's Wrong—L. O. Marsteller, Radio Engineer, Westinghouse Electric & Manufacturing Co., Tells How Different Types of Receivers Should Be Tuned

A RADIO listener tuning in late on a program can be just as much of an annoyance to those around him as if he were actually arriving late at church or concert or theater, making a noise and fuss about getting his seat, and obstructing the view.

Do you tune by the hit-or-miss method? But you would not play baseball that way, or tennis. You would break other people's windows. You wouldn't play bridge that way, or you would likely break your own pocketbook and your partner's heart. A logical, scientific method of doing anything is always to be preferred. It gives the best results, the greatest satisfaction and causes the least trouble.

You have probably very little idea of the amount of trouble you cause by tuning your receiver by a hit-or-miss method. Every night you may—unknown by yourself—be causing a horrible annoyance to the neighbors with whom you most desire to keep on friendly terms. If your formerly sociable neighbor for some unaccountable reason avoids you, or frowns at you or looks a frigid scorn at you—just consider if you have possibly been tuning some of your unskilfulness and thoughtlessness into his radio receiver night after night. What wonder he cuts you dead, or slanders you!

Yet it is so very easy to tune your receiver in a proper and entirely unobjectionable manner. Here is the way of it.

* * *

There are several types of receiving sets which will act as transmitters, and which will, if improperly tuned, annoy your neighbor with squeals and whistles. One of these is the single circuit receiver. There are two controls on a single circuit receiver. One of these controls is known as a tuner handle or knob. This control makes it possible to tune in one station and eliminate another. The other control is a tickler or intensifier. Its purpose is to increase the signal strength. Both tuner and tickler should be operated simultaneously. Now let us consider the proper operation of this set.

Tuning the Single Circuit Receiver

With the tickler set near zero, bring the tuner control to approximately the setting where you would expect to find the desired signal, and, with the other hand bring the tickler control up to the point where a slight hiss or rustle is heard and keep the tickler so adjusted as you more accurately tune in the signal. Never increase the tickler beyond the point where the hissing sound is heard or you will hear a whistle or squeal, indicating that you are sending out an interfering wave which will interfere with your neighbor's reception.

If a slight change of the tuner adjustment causes a squeal or whistle to be heard, you should immediately remedy matters by decreasing the tickler until the whistle disappears. If you do not decrease the tickler setting, your set will continue to act as a transmitter and radiate an interfering wave. This will cause your neighbors to receive a whistle mixed in with the concert music from the broadcasting station. Many times music of excellent quality is condemned because of the interference caused by the wave sent out from a neighbor's receiving set.

With a very little practice the single circuit receiving set can be operated night after night without causing any interference.

Another type of receiver which often finds a place in the amateur's home and sometimes is used for broadcast reception, has one more control than the single circuit set, making a total of three controls. This is known as the three-circuit regenerative receiver.

The Three-circuit Regenerative Receiver

One control tunes the primary or antenna circuit and the other tunes the secondary or tube circuit. The third control is marked tickler or intensifier. This receiver is very selective but requires considerable skill and patience in order to tune in weak signals. As this type of receiver has three controls, and, as the average person has but two hands, it is rather difficult to keep the tickler properly adjusted as the primary and secondary controls are operated. The general tendency is to set the tickler to maximum and then tune the primary and secondary until the whistle-like note of a broadcasting station is heard. That means that the operation has probably interfered with your neighbor's reception of the concert.

For people who only have two hands, there is only one way to operate such a set and not cause interference,

In this pleasing radio atmosphere in an exclusive Manhattan millinery shop it should be a joy to select a hat; but the purpose of this picture is to show how NOT to tune your receiver. Two controls demand the use of both hands. The radio receiver is like all good musical instruments in this respect

that is, to calibrate the secondary circuit by marking the proper setting down on a chart. Then to tune in a station it is only necessary to set the secondary control to the proper point as determined from the calibration chart and adjust the tickler to the point where a slight hiss or rustle is heard as the primary circuit is tuned to the desired signal. This type of receiver should be used only when it is at a sufficient distance from other sets to preclude the possibility of interference.

Untuned Radio Frequency Receivers

So far we have considered regenerative receivers which are thought by many to be the sole source of radiation. But this is not the case. In sets which introduce radio frequency amplifier stages, oscillations may be set up which radiate as effectively and cause as much annoyance as the regenerative receivers. The oscillation of the radio frequency amplifiers may be prevented by means of the potentiometer or stabilizer.

This picture shows Mayor George E. Leach of Minneapolis tuning his set properly. His right hand is adjusting the regeneration control while his left hand manipulates the wave-meter dial

The only practical way of determining the point on the potentiometer dial beyond which the tube will oscillate is experience in tuning this set. As the effect of tuning this dial is noted, one should remember for the commonly used wavelengths the critical points on the dial, at which the oscillating effect becomes audible in the phones or loudspeaker—and thereafter be careful to adjust to those points and not a bit beyond.

How far will any of these types of receivers transmit? Any one will cause interference over a distance of four city blocks and can under most favorable conditions be heard six blocks away, or even much farther.

So every radio listener should remember: When the detector tube of a receiving set oscillates, the antenna connected to that set radiates energy which is picked up by neighboring sets in the form of "birdies" and squeals. Actually, of course, these "birdies" or beat notes are the audible frequency difference between the inaudible high frequency wave transmitted from the broadcasting station and the inaudible high frequency current produced by your oscillating detector tube.

Correct Tuning. The Reverend John G. Gebhard of Mount Vernon, N. Y., knows how to get the best results from his set. And, being a divine, he practices the Golden Rule. With his left hand he controls regeneration while the right adjusts wavelength

You can usually tell when your tube is oscillating by a peculiar change that takes place at the beginning of oscillations. There is often a slight swish or rustle as the tickler reaches the oscillation position and it should be backed slightly below this point.

Your search for a distant station should always be made with the tube near to, but always below, the oscillating point and the tuning can then be done with no inconvenience to anyone.

One more caution: You must not be satisfied that because you hear no squeals in your own receiver you are causing no disturbance in that of your neighbor. You may obtain quite clear music or speech from your own, yet your set may be oscillating and a few meters from you your neighbor is receiving your radiation and that from the station at the same time. At times they add and give double strength and then they substract and cancel the unmodulated carrier wave from the station, causing a doubling of pitch. So your neighbor's program is ruined without any apparent beat note, and the trouble is not apparent at your own receiver.

An effective method for determining if your set is oscillating is the following:

In tuning, when you come to the station you desire, turn the wavelength control dial back and forth over the spot where the station is found. On either side of the exact tune there may be noticed a squeal rising in pitch as you leave the station. If this condition is present, your set is oscillating and the tickler should be turned back. Do not be tempted to turn it forward to get additional volume.

In radio every listener-in should conform to the Golden Rule.

Broadcasting Station at Santiago, Chile

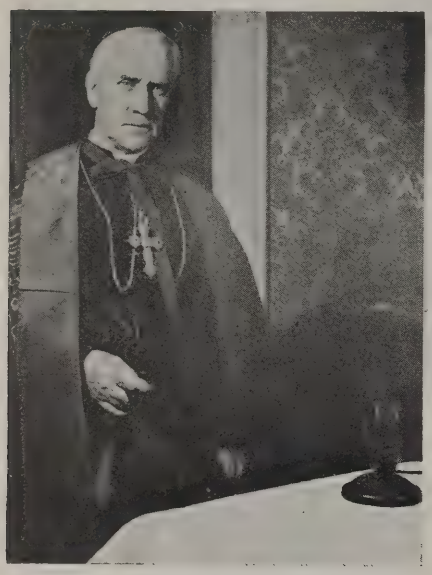
ONE of the best of the South American broadcasting stations is that of Santiago, Chile. This station has a power of 500 watts, and operates with a wave-length of 460 meters. A distinctive feature of its broadcasting is the use of an assortment of microphones so that an appropriately designed microphone may be employed with each different class of instrument—string, woodwind, voice, etc., thus enhancing the quality of transmission of musical programs, which have been heard satisfactorily in Buenos Aires, Bahia, Blanca, Bolivia and Peru.

Brazilian Broadcast Stations

PERMISSION to establish four radio broadcasting stations has been granted by the Ministry of Public Works of Brazil to the Brazilian Radio-Telegraph Company for the purpose of broadcasting information, lectures, concerts, etc. The four stations are to be located at São Paulo, Bello Horizonte, Bahia and Pernambuco.

This past year the Radio Society has been active in Rio de Janeiro and now counts about 800 members. This society has been operating a small 10-watt broadcasting station at 10 Avenue Rio Branco.

Service and Song Together



Patrick Cardinal Hayes broadcasting from WEAF

MR. FRANK E. MULLEN, Radio Editor of "The National Stockman and Farmer," writes us:

"The radio industry in discussing broadcasting has been concerned too much with the entertainment side of radio, which is necessarily a changing phase, and too little with the service side of radio, which is certain to endure.

"In your April number, the music controversy, the future of radio, and what is to be done, was discussed, but with little or no mention made of the service features of radio. The entertainment problem was emphasized . . . ."

* * *

ENTERTAINMENT, up to April, was paramount. The Press, over the entire country, has emphasized that phase of broadcasting. But a change is already upon us. Entertainment has blazed the trail for the service features of radio. From entertainment and service combined, culture evolves. We may have national service, with the improvement of broadcasting, and perhaps, soon, have an intimate international relationship founded on international service.

* * *

MR. MULLEN continues: "Our experience has been with a particular radio audience that will inevitably use radio primarily as a service and enjoy it as a blessing to life. We do not mean to minimize the importance of music and other radio entertainment. They are essential, but radio could and would live on service alone were all artists, musicians, composers, etc., in the world to go on a permanent strike. It is equally true that such service warrants, and will receive compensation of some sort; that is to say, the service is so essential that it will be paid for if need be."

* * *

SHOULD all the artists, composers, and musicians go on a permanent strike, this world of ours would be a sad place. And one wonders, too, whether the service of which Mr. Mullen speaks would have gained a foothold had there been no entertainment to encourage the building of broadcast stations sufficiently powerful to reach a wide area.

Anita Brown, National Radio Chairman, League of American Pen Women, broadcast from WJY

An enduring broadcasting service in America must function as entertainment, or at least be closely allied with features that entertain.

The American people study their political lessons by cartoons. The "Congressional Record" with its gratis circulation has probably little influence as compared with the Sunday newspapers carrying comic supplements.

The churches employ organ recitals and choir singing.

* * *

ENTERTAINMENT is essential in radio broadcasting; but broadcasting has unquestionably progressed toward greater service.

The National Conventions this June will be attended by radio millions who could never before attend. Many will listen in who could not otherwise afford the time and expense to go direct. Many others will listen in who have been reluctant to attend any sort of a political caucus merely because they felt that a lack of understanding would hardly reward the effort expended.

Through broadcasting we will learn American politics. We will learn the fundamentals by radio, and then *read* the embellishments with a well balanced perspective.

* * *

SOME years ago, a convention of religions was held in Chicago. Among others, were represented Christianity, Mohamedism, Brahmism, and Budhism. The history of religion was reviewed. Then notes were compared.

Many people were astonished to learn that some of our most valued axioms are in the Bible of Brahma faith; "penny-wise and pound foolish," and "do unto others as you would have others do unto you." In fact, the Golden Rule was found to be the key-note of Hindu religion.

The Mohamedans teach five points of which "give honest weight," and "revere thy father and mother" are examples commonly thought to be Christian tenets.

The followers of Buddah believe in brotherly love. That isn't a bad religion.

And the Christians discovered 144 different sects in this country alone. A little more knowledge of religion

Judge Ben B. Lindsey, famous juvenile court judge of Denver, broadcast from KHJ

Mildred Delma, coloratura soprano of Metropolitan Studios, broadcast from WJZ

and religions won't hurt any of us. Perhaps broadcasting will serve us in this way, too.

* * *

BROADCASTING will render a profound service this summer. Broadcast stations have increased their programs of religious services. Those who want it will have it. Those who are indifferent to church activities will profit in spite of themselves.

For in broadcasting we may hear the best services, and of a divergent character. We may listen in on debates that have engaged theological scholars for centuries. We will learn some of the fundamentals of religion, unknown to us before, and then we may be inspired to *seek* the history and philosophy of religion; and imbibe a little of the wisdom of the ages.

* * *

SHOULD broadcasting do little more than pique our temperamental curiosities it has truly become a service.

Politics concern our economic structure. Religion has to do with our spiritual existence. Broadcasting will surely open our eyes to many things in each that we have not yet learned.

Tune in on both this summer.

"OUR present system of broadcasting market reports," continues Mr. Mullen, "includes three reports daily and two weather reports from KDKA. In the morning, the crop and market information, as released by the United States Department of Agriculture, is broadcast after the live stock quotations have been given. At noon the weather forecast is given, the Pittsburgh livestock market repeated, a report on wholesale fruits and vegetables, and miscellaneous reports. Our evening broadcast includes a report on nine principal livestock markets: Chicago grain, New York Cotton and Sugar, Feeds at six primary markets, Baltimore and Philadelphia grain, Pittsburgh wholesale produce and dairy products. Toledo Seeds and Chicago butter and eggs.

"The reaction to the above broadcast has come from 47 states, Canada and Cuba."

Manifestly a fine record of a year's splendid service!

Above: Wendell Hall, the red-headed music maker, broadcasting from WEAF

Below: Ernest Hare, Larry Briers and Billy Jones, the Happiness Boys trio of phonograph fame, broadcasting from WEAF

Mrs. Minnie Maddern Fiske, the famous actress, broadcast from WJZ

* * *

MR. CHARLES TITTMAN has appeared with New York Symphony, Philadelphia Orchestra, Detroit Symphony, Baltimore Symphony, New York Oratorio Society, Chicago Apollo Club, at Bach, Cincinnati, Cornell and Spartanburg Festivals, at the New York Oratorio Society Festival of 1920, etc., and in recital at prominent colleges and for leading music clubs. He is an American, born and trained in America, a graduate of Princeton and of the Harvard Law School, and occupies a distinguished position on the American concert stage. He is particularly well known through his many appearances at the celebrated Bach Festivals, and in concert he has sung with such distinguished artists as Matzenauer, Garrison, Mary Garden, Heifetz and Casals. In festival he has appeared with most of the great stars of the day, including Homer, Raisa and Martinelli. In recital he has been particularly well received.

He returned to the

Keith McLeod (left) accompanist at WJZ. Mr. McLeod is a musician worthy of the position to which his ambition is now leading him. (Below) Edward A. Kaminsky, Paul Hyman and Mack Stock. This trio accompanied by McLeod "put over" the last Wireless Age party from WJZ. Alfred Armand was the leading soloist

concert platform in 1920, after service as First Lieutenant, Captain and Major in the Army. Since, he has become a Victor artist of renown.

And that is why his appearances before the microphone at WRC have been worthy events. It will be well worth your while to listen in on Mr. Tittman at any time he may broadcast.

But don't let it go at that. Learn about your broadcast artists. Tune in on their performances. Your radio is a season ticket to the concert halls of the country.

* * *

A POPULAR feature of CKY'S programs are the readings from the works of Rudyard Kipling and Robert W. Service, which are given by D. R. P. Coats. Recently the announcer commenced a series of readings from the works of Charles Dickens. Following "Sidney Carton's Farewell" made famous by Sir John Martin Harvey, a schoolmaster wrote to CKY congratulating the station and saying that the readings had proved of special interest to the students of grade eleven who were reading "The Tale of Two Cities" as one of their texts for the year. The schoolmaster suggested that readings might also be given from Shakespeare and from other works in use in the schools. Accordingly, CKY is taking the matter up with the educational authorities, and pupils in the Prairie Provinces are to have an opportunity of hearing extracts from works, which they are studying, read over the radio.

Our educational system seems to follow in the wake of progress. It has been hard to understand why moving pictures have not been exploited in the schools to a greater extent. Perhaps, however, broadcasting will promptly enter the curriculum of teaching. Moving pictures and radio might well be combined for the teaching of subjects that are now difficult to learn.

* * *

PRESENTING the greatest assemblage of leading orchestras and famous recording artists which radio broadcasting has ever known, station WJZ of the Radio Corporation of America transmitted the entire program of the annual Banquet and Entertainment of the Talking Men and Radio Men, Inc., direct from the grand ball room of the Hotel Pennsylvania. Through the courtesy of the American Association of Authors, Composers and Publishers, WJZ was able to broadcast all numbers controlled by the Association copyrights, insuring the listeners-in a continuous program of unequalled entertainment.

Among the orchestras and entertainers who were presented to the radio audience in unbroken succession from nine o'clock until the end of the program was Paul Whiteman and his Orchestra, Selvin's Boardwalk Orchestra, Coleman's Mont Martre Orchestra, Vincent Lopez and his Orchestra, Paul Specht's Orchestra, Ace Brigode and his Ten Virginians, Ambassador Orchestra, Garber-Davis Orchestra, Piron Orchestra, International Novelty Orchestra, Keating's Ramblers Orchestra, California Ramblers, Marion Harris, Van and Schenk, E. Ricard, Irving Kaufman, Colin O'Moore, Brooke Johns, John Steele, Brox Sisters, Marcia Freer, and Eddie Cantor.

All the performers are famous recording artists, and many of them are radio feature performers. Their presence at the banquet and the broadcasting of the program was made possible by courtesy of Landay Brothers Music House, and the Brunswick, Columbia, Edison, Okeh, Victor, and Vocalion Companies.

* * *

A NEW invention has made possible the recording of broadcast programs on records which may be rebroadcast, and then again recorded.

The all-star assemblage, broadcasting from WJZ, should have been recorded. The records could then be preserved for their historical value. Two years from now we may have occasion to study the evolution of broadcasting. It would be interesting to know in what direction we had advanced.

* * *

THE enterprising State College of Washington studied the broadcast situation from a practicable point of view; the service facilities. Satisfied that a broadctst station which would devote itself primarily to information and high class entertainment would be almost a necessity in a public educational institution, the authorities immediately proceeded to raise the necessary funds. Support was secured from the student body, citizens of Pullman and nearby towns, and the alumni was solicited.

The Government gave the State College of Washington an exclusive

Mme. Tamaki Miura, the "Madame Butterfly" of Japan, recently sang from KYW in Chicago while her mother listened in at Tokyo. Mme. Miura received 10,000 requests for her autographed photo from the United States, Mexico and Canada. She autographed her name in Japanese and English, requiring 20,000 signatures

wavelength, 330 meters, and christened the Station KFAE.

The station then invited all listeners to send in their preferences in program material. KFAE now broadcasts basket ball games, talks on agricultural engineering, the migration of birds, chemistry and other educational subjects, orchestral numbers, solos, and talks on books.

The programs are developed through the activities of the faculty and students under the management of Arthur J. Kralowec, a senior student.

Tune in on KFAE. Then decide whether you have any definite ideas on broadcast service.

* * *

RADIO fans all over the country will be fortunate this year in being able to hear the opening Pop concert at Symphony Hall, Boston, played by members of the Boston Symphony Orchestra which will be broadcast by Station WBZ, Boston Herald-Traveler, Westinghouse. These concerts are conducted by Agide Jacchia, directing a symphony of 80 players which is adequate for playing the most elaborate modern score.

H. V. Carpenter, Dean of Mechanical Arts and Engineering, supervised installation of KFAE

These Pop concerts are so much a part of Boston as the Common or the golden-domed state house and they are unique in the fact that there is nothing like them anywhere in this country. In the summer of 1885 the project of a supplementary series of concerts to the regular season of the Boston Symphony Orchestra, of popular character to suit the warmer season, was inaugurated. After the example of Bilse concerts in Berlin, the formal rows of seats were removed, tables installed and refreshments were served.

The experiment was an instant success. The "Promenade Concerts" soon came to be called the "Pops." While

Mary Ellis, Arthur Hammerstein's new star, broadcast from WJY

the Pops of this the 39th season follow the original idea to some extent, the idea has been enlarged to a great extent. In the first place, the orchestra has grown considerably—its full symphonic proportions are adequate and the music is taken somewhat more seriously, although light trifles for encores, waltzes, operetta selections, remain an integral part of the Pops.

This is Agide Jacchia's eighth season as conductor of these concerts. A native of Pesaro, Italy, he became a favorite pupil of Mascagni at an early age in the Conservatory of that season, Mr. Jacchia made an immediate mark as a young man as a conductor in the principal opera houses of Italy.

Since coming to this country, Mr. Jacchia has conducted opera from coast to coast and from Canada to Central America. During the season of 1914-1915 he was the principal Italian conductor at the Century Theater in New York. He is the founder and director of the Boston Conservatory of Music. * * *

North Hudson Kiwanis Club Quartet broadcast from WJZ

"I SEE by the Papers" is the title of a new radio series offered by "Hollywood" McCosker and scheduled to be broadcast weekly from WOR during the summer months.

The series is to be a humorous résumé of outstanding news events patterned after the style of Will Rogers' satire on well known people and events of national importance. Mr. McCosker, who is a newspaper man and motion picture critic well known to the radio audience, will offer the new series throughout the summer at which time there is a pronounced let-up in the release of big movies.

"Hollywood" is of the opinion that radio programs are lacking a humorous vein and that thousands of the radio audience will welcome the unconventional. "In any event," he writes, "my attempting to kid the week's news is a good joke to start with." * * *

Charles Tittman, America's leading Oratorio Bass, broadcast from WRC

ALTHOUGH the Chautauqua Circuit has eliminated "Jazz" and humor, particularly comedians, this season, because those numbers have not been requested, the radio audience will probably welcome a smattering of something light with their summer programs of politics and religion.

B. C. L.'s now have greater advantages than Chautauqua audiences have enjoyed in the past. Cultural programs in broadcasting will show continual improvement. Also we shall have humor. We need some humor. Humor is a great educator.

—W. A. H.

RADIO NEWS FROM ALL OVER THE WORLD

Leper Colony at Molokai, Hawaii, Hears KDKA

THE great amount of enjoyment that radio broadcasting has brought to those isolated from the rest of the world is clearly shown in a communication just received at Westinghouse Station KDKA, from the Kalaupapa Leper Settlement on the Island of Molokai, Hawaii, said to be the loneliest place in the world.

Recently under the personal supervision of R. L. Cooke, superintendent of the Wireless Department of the Mutual Telephone Company of Honolulu, two radio receivers were installed in the leper colony. The radio sets consisted of a Radiola V, equipped with an A. C. power amplifier and an R-3 Magnavox which was installed in the amusement hall; while a Radiola II, for ear phone reception was installed in the superintendent's home.

The very first time the sets were placed in operation, KFKX, Westinghouse repeating station at Hastings, Neb., was received repeating KDKA's program. Then a few minutes later KDKA was picked direct.

Later KDKA was again received with such good volume that the music and other entertainment could be heard about 100 yards outside of the hall.

There are about 600 people in the Molokai leper settlement. About 400 were present for the first radio night.

The leper colony is located on a long narrow point of land surrounded on three sides by the ocean and backed up by steep cliffs, 1300 feet high which are practically unclimbable.

There are only two ways of entrance, by sea or over the steep mountains, down a narrow trail that seems to drop right out from under the cliffs. The two radio receiving sets were packed down this trail.

In the future these afflicted people outcast from the remainder of the human race will at least hear from the outside world through the medium of the radio wave.

Janitor Must Know Radio

IF builders throughout the country continue to erect apartment houses and furnish tenants with radio entertainment from a central receiving station, janitors will have to be able to operate receiving sets and handle complaints.

In Washington, several apartment owners object to numerous aerials of many different types, which they claim disfigure the roofs. Other landlords, more thoughtful as to the comfort and happiness of tenants, are installing one aerial with a receiving set in the basement and running wires to sockets in each apartment so that occupants who desire may plug in phones or loud speakers.

LIFE BOATS EQUIPPED WITH RADIO

The newest Giant of the Seas, the steamship "Columbus" of the North German Lloyd Line, which arrived recently in New York after her maiden voyage, has the most up-to-date equipment in its radio installation. Passengers on this vessel will feel greater safety when they observe the lifeboats equipped with radio. The boats have small receiving and sending sets, with aerial as shown in the photograph

"Listening In" in Lombardy

THE Italian society "Amici del'Arte" has constituted a new branch of its activities, the "Radio Club Lombardo," with headquarters at Milan, and with sections in other cities and towns of Lombardy.

It is the intention of the organization to encourage students and amateurs of radio communication, to advance the adoption and improvement of radio, promoting and supporting the erection of well-organized stations.

The society's activity is seriously limited by the fact that, while a person or an organization may purchase a radio outfit, it is impossible to obtain the Government's sanction to use it.

Balloon Guided by Broadcast Station

ADRIFT in the upper air currents for nearly twenty-four hours, carried whither the winds blew them, two government officers had for their only means of communication the radio.

They have completed several of the free balloon flights being made from Scott Field, Illinois, by the U. S. Weather Bureau to establish the value of the forecasting theory.

A map of the country is carried in the balloon, and by information broadcast from different radio stations, they know their location and the weather reports and forecasts from Washington.

These tests are the first ever attempted, and fifteen are planned. Dr. C. LeRoy Heisinger, meteorologist from Washington, and Lieut. James T. Neely, of the army air service, who are manning the balloons, attribute the complete success of their flights so far to warnings of weather changes received by radio from various stations.

British Interest in Radio Increasing

ENTHUSIASM for radio telephony continues to grow throughout Great Britain, according to Acting Commercial Attaché Hugh A. Butler. Up to March 1, 1924, over 600,000 licenses for receiving sets had been issued. And it doesn't stop here. THE WIRELESS AGE has just received word from Mr. Arthur R. Burrows, Director of Programs of the British Broadcasting Company, whose interesting account of Broadcasting in the British Isles was published in one of our recent numbers, that the official number of license holders in Great Britain is now 750,000. He states further that it is intended to tap four new populous centers by opening relay stations at Edinburgh (2EH), Liverpool (6LV), Leeds-Bradford (2LS), and Hull (2HU) this summer.

Broadcasting in Switzerland

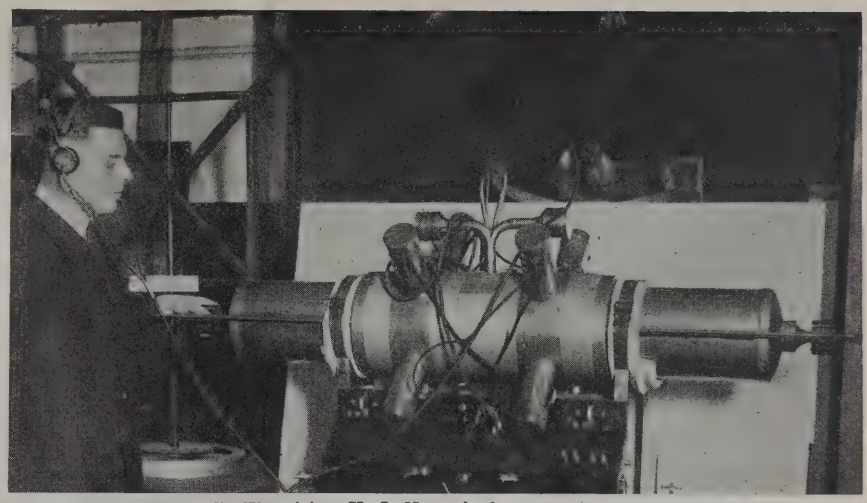
RADIOTELEPHONY as a national pastime, such as it has become in the United States and England, appears to have no great future in Switzerland. It was originally intended to erect a central national broadcasting station, but this idea has been abandoned, and a system of decentralized stations is now proposed. In view of the fact that there are only about 4,000,000 people in Switzerland, it is quite obvious that broadcasting must be kept within modest bounds.

It is reported that arrangements are being made for the erection within the near future of four broadcasting stations. They will be located, respectively, at Lausanne, Geneva, Zurich and Basel. Plans are now being prepared for the station at Basel, and the installation work will begin at an early date. The work of constructing the station at Zurich has been temporarily retarded pending certain financial adjustments, but the promoters hope to be able to complete the undertaking without much further delay.

The chief difficulty to be encountered is the expense of providing programs. The Swiss Federal Government is giving its encouragement and assistance to the undertaking, and has decided to place at the disposal of the four stations the larger part of the revenue derived from the licenses issued to amateurs. Industrial circles, amateurs, public corporations, and other interested bodies are being urged to subscribe to the scheme.

Austrian Broadcasting Company to Be Formed

FORMATION of a company called "Broadcasting A. G." is being undertaken by the Austrian Government to carry on radiotelephone broadcasting in that country, we are advised by the Department of Commerce. Applications for radio concessions from the German Telefunken Gesallschaft, the E. Schrack Radio Werke, and other companies had been pending, but it was decided not to grant a concession to any privately owned concern. A majority of the shares of stock of the new company will be held by the Austrian State.



R. L. Luke, Chief Radio Electrician, U. S. Navy, is demonstrating here the Scotch Clariphone, designed to modify the effect of atmospheric disturbances in radio reception

African Natives to Learn Farming by Radio

NATIVES in the heart of Africa will be able soon to perform their ancient ceremonial dances to the strains of jazz through a radio loud speaker, and will be given instructions in modern agricultural methods in the same way under plans of British officials of Kenya Colony.

Trade Commissioner R. A. May at Alexandria, Egypt, has advised the Commerce Department that plans already have been made to institute a radio set with loud speaker in every village.

Besides daily musical programs, he said, farming instructions will be sent to the natives in their own language.

Radio "Knife" for Major Operations

APPLICATION of radio impulses to a surgeon's knife which burns its way through the tissues of the body, cauterizing as it passes and thus produces nearly bloodless surgery, is claimed by Dr. L. E. Schmidt of the staff of the Alexian Brothers' Hospital, Chicago. With the use of the new instrument two operations for cancer of the bladder have been performed successfully, it is stated.

As explained by W. H. Dodge, representative of the laboratory that perfected the device, a low power radio transmitting set is used to generate the current. The "knife," which is about half the breadth of a lead pencil and resembles a knitting needle, forms one terminal. The other is applied to the patient. The human tissue offers resistance to the passage of the current

Chile is using radio extensively. Here is the wireless station north of Valparaiso, Chile, one of many stations built along the coast for the aid of shipping. Recently a fine broadcasting station has been opened in Santiago, the capital

Here is how Paris enjoys radio in the summer-time. Concerts are broadcast from a band-stand in the Champs-Elysees

when the knife is applied. The resistance causes heat. The knife burns itself through skin, fat and muscle quickly and without pressure.

The set is equipped with two 40-watt power tubes and condensers. The current oscillates at the rate of 40,000 cycles a second. The tension is 800 volts at 450 milli-amperes. The heat developed is great enough to fuse brass.

"We don't care to make any rash statements," said Dr. A. J. Wochinski, who assisted in the operations. "Radio surgery has its limitations. It will not cure cancer, but can be used practically wherever the knife can.

"The one advantage the radio needle has over the knife is that it prevents loss of blood, unless a large artery should be severed, in which case ligatures would have to be applied. The patient is thus saved the usual shock that follows major operations."

WHN Pays License Fee

THE suit for infringement of patent brought by the American Telephone and Telegraph Company against Station WHN has been dropped because of an agreement reached between the parties whereby WHN takes out a license from the telephone company covering the use of the radio parts which were declared to be infringements. Henceforth WHN will operate on the same basis as other stations licensed to broadcast by the telephone company. The license fee was $2,000, which is understood to hold for the life of the patents.

In discussing the settlement of the suit officials of the American Telephone and Telegraph Company said: "The action taken means only that this company meant what it said when President Thayer issued his statement. Our position has been that there is nothing else for us to do but protect the validity of our patents when we believe they are infringed and put the decision up to the courts.

"We have said all along that we were perfectly willing to license any station which would respect our patents by applying for a license to operate under them. Our willingness to license Station WHN shows our intention to adhere to this position. We believe that other stations now operating with apparatus that infringes on our patents will apply for license and that this situation will be straightened out."

The only difference that will exist between Station WHN and the other broadcasting units licensed by the American Telephone and Telegraph Company is that the WHN apparatus was not manufactured by the Western Electric Company, which manufactures and sells the broadcasting sets installed under agreement with the telephone company.

The radio industry, which has watched the progress of the WHN suit as a test case of broadcasting control, was interested to learn the terms of the license agreement. Its principal conditions are given on good authority as follows:

1. The telephone company releases WHN from all liability of claims for past infringement arising out of previous operation of the broadcasting station.

2. WHN is granted a "personal non-transferable" license to continue to use the station for radio telephone broadcasting, including broadcasting for toll or hire.

3. The license fee is set at $2,000, which is understood not to be an annual fee but a sum covering operation during the life of the patents under which license is granted.

4. The present license is based on the operation of the station, with a maximum power of 500 watts delivered to the antenna, but the telephone company agrees that it will at any time, upon request of the licensee, grant a license as far as its patents are concerned to operate with greater power upon terms commensurate with the present license fee.

5. The license is subject to revocation by the telephone company upon violation by the licensee of any of the foregoing conditions.

Hoover on Radio Legislation

HERBERT HOOVER has become the Judge Landis, the Will H. Hays, the Augustus Thomas of the air.

He announced recently that he would not attempt to set up a censorship and would never consent to any scheme by which radio listeners shall be charged a fee by law.

The Government of the United States will always control the ether roads, but it will not be drawn into saying what shall and what shall not be fed to the radio audience.

"There are enough complaints now," says Mr. Hoover, "against the individual programs sent out by the various broadcasting stations. If the United States were to assume control of these programs, the kicks would be multiplied by the tens of thousands and the first thing we knew we would be having a Senatorial investigation on our hands.

"There will be," he explains, "no vested right in any one wave length.

The Eiffel Tower radio broadcasting station in Paris. Here are the tubes

There will be no monopoly of certain roads in the ether. The Government will see that the air is kept open to all comers. The Government will do

everything it can to encourage continuity of service from any one broadcasting station. Certain companies are so tied up in the development of radio that there is reason to believe they will show great vision in handling the subject. In any event, while they may control radio instruments, the Government will never lose control of the air itself and will never permit the air routes to be run counter to the general public interest.

"There has been no parallel to the development of the air as a means of communication since the invention of printing. The radio is the handmaiden of the printer. The Government will see that nothing happens in the ether to interfere with or hamper its future."

Republican Convention by Radio

MORE than one-tenth of the people of the United States, or about twelve million, can "tune in" on the proceedings of the Republican National Convention when it starts at Cleveland, Ohio, on June 10.

Radio in Mexico. A news reporter is here sending out messages from the powerful portable set accompanying the forces of General Gonzalo Escobar in campaign

Every radio set owner in the country, whether he is on the Pacific or Atlantic Coast wave length, will be able to hear the convention. Arrangements to broadcast the convention proceedings are being completed by the Radio Broadcasting Subcommittee of the Cleveland Convention Committee, headed by Charles L. Gebauer.

"More people will hear this convention than ever heard any great political event before," said Secretary James L. E. Jappe, of the Cleveland Committee. "First, there will be more than 13,000 in the public hall itself, either as participants or spectators. Then there will be a loud speaker that will enable forty to fifty thousand gathered outside of the hall to hear, and finally the proceedings will be broadcast over the land." The roll-call by States on President and Vice-President, will be broadcast.

Chess by radio. F. E. Black, chief wireless officer of the S.S. "America," indulging in a game of chess aboard ship

Standard Radio Frequency Transmissions

THE Bureau of Standards is transmitting special signals of standard frequency about twice a month. The signals can be heard and utilized in general east of the Mississippi River. These special signals of standard frequency are of use to testing laboratories, transmitting station operators, and others in standardizing wave meters and adjusting transmitting and receiving apparatus. The transmissions on June 5 will be of special interest to ship operators, those on July 7 to amateurs, and those on June 20 to broadcasting station operators. The accuracy of these signals is better than three-tenths of one per cent.

All transmissions are by unmodulated continuous-wave telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal" and "announcements." The "general call" is given at the beginning of the eight-minute period and continues for about two minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters WWV intervening. This signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted, and contain a statement of the measured frequency. An announcement of the next frequency to be transmitted is then given. There is then a four-minute interval while the transmitting set is adjusted for the next frequency.

The schedule of standard frequency signals from the Bureau of Standards is as follows:

SCHEDULE OF FREQUENCIES IN KILOCYCLES
(Approximate Wave Lengths in Meters in Parentheses).

Eastern Standard Time	June 5	June 20	July 7
11:00 to 11:08 PM	300 (1000)	550 (545)	1363 (220)
11:12 to 11:20 PM	315 (952)	650 (461)	1430 (210)
11:24 to 11:32 PM	345 (869)	750 (400)	1500 (200)
11:30 to 11:44 PM	375 (800)	833 (360)	1600 (187)
11:48 to 11:56 PM	425 (705)	940 (316)	1700 (176)
12:00 to 12:08 AM	500 (600)	1050 (285)	1800 (167)
12:12 to 12:20 AM	600 (500)	1150 (261)	1900 (158)
12:24 to 12:32 AM	667 (450)	1250 (240)	2000 (150)

Radio Expositions

THE Pacific Radio Exposition is planned to be held in San Francisco from August 16 to 21 in the Civic Auditorium. This exposition will be conducted by the Pacific Radio Trade Association.

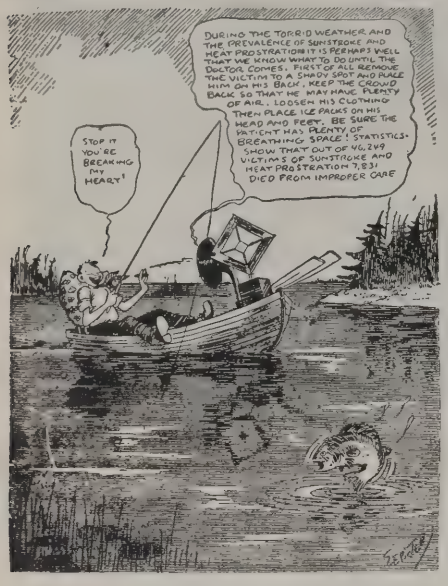
Chicago this year will be the scene of the second of a series of three shows comprising the first annual International Radio Exposition. The Chicago show will be conducted at the Coliseum November 18 to 23 inclusive.

The first show will be at Madison Square Garden, New York City, beginning Monday, September 22, and closing Sunday night, September 28. The third show will be held in a Pacific coast city, soon to be selected, in January or February, 1925.

The exposition will be under auspices of the newly organized Radio Manufacturers' Show association, with a membership of sixty. U. J. Herrmann and James F. Kerr, who made a success of the annual Chicago show, will be managing director and general manager respectively.

Best Bets in Humor

MUSIC BY H. T. WEBSTER


DURING THE TORRID WEATHER AND THE PREVALENCE OF SUNSTROKE AND HEAT PROSTRATION IT IS PERHAPS WELL THAT WE KNOW WHAT TO DO UNTIL THE DOCTOR COMES. FIRST OF ALL REMOVE THE VICTIM TO A SHADY SPOT AND FANNING HIM ON HIS BACK, KEEP THE CROWD BACK SO THAT HE MAY HAVE PLENTY OF AIR. LOOSEN HIS CLOTHING. THEN PLACE ICE PACKS ON HIS HEAD AND FEET. BE SURE THE PATIENT HAS PLENTY OF BREATHING SPACE! STATISTICS SHOW THAT OUT OF 46,249 VICTIMS OF SUNSTROKE AND HEAT PROSTRATION 7,831 DIED FROM IMPROPER CARE
STOP IT YOU'RE BREAKING MY HEART!

—*N. Y. World*

H. L. M. Writes

ONE night (his letter goes) a friend asked me over to his house to "listen in" on the radio.

I went.

During the course of the evening I heard a weather report broadcast from a Colorado station.

The idea of hearing a Colorado weather report thrilled me. It seemed so—you know—impossible. That Colorado should have weather.

I asked him if I might come over the next night. He said I might.

I told him I liked it, thought it was great. I did not tell him about the Colorado weather report. That was my secret.

The next night I heard a weather report from Chicago. It was wonderful. "Cloudy in the southwestern portions, with gradually increasing temperatures," I was ecstatic. I hardly slept a wink that night. A weather report from Chicago!

I went night after night, listening raptly to reports from all sections of the country.

I bought a set of my own.

They can hardly tear me away from it.

I know what the weather was yesterday, is today and will be tomorrow in every important section of this great United States.

I don't know how I could live without my weather.

That's how I became a radio fan!

Hoping we both enjoy the concert Monday night, I remain,

Radiofanly yours, H. L. M.

THAT LITTLE GAME—BY B. LINK

YOU'RE A NICE ONE, YOU ARE,— SIT UP HALF THE NIGHT PLAYING A GAME AND THE OTHER HALF LISTENING IN ON THE RADIO AND ALLOW THE WATER PIPES TO FREEZE BEFORE YOUR VERY EYES-
DEARIE, CAN YOU BLAME ME FOR FORGETTING ABOUT THE FRIGID WEATHER OUTSIDE?- THE CARD GAME WAS A HOT SESSION AND THE RADIO PROGRAM AN OPEN AIR BAND CONCERT BROADCASTED FROM CUBA-

—*Brooklyn Times*

That's Easy

OKLAHOMA Radio Dealer (after lengthy explanations to Osage chief): Now I've gone over this radio set thoroughly with you; I've shown you every coil and knob, and I'd like to have your order. But is there still anything you don't understand; any questions you would like to ask?

Chief: Yes, what makes it go?

—Oklahoma Whirlwind.

The New Control

"I SEE that you don't know how to tune this set," he observed, as he began adjusting the dials. "But don't let that worry you, old man; we all have to learn, you know. Now, then," he continued, "did you notice the increased volume of sound as I turned that last dial? Just put the finishing touch on perfect reception, as it were. Of course, one cannot teach you the whole game at one sitting, but I'll say this much: you'd do well to pay particular attention to that dial if you want good volume. That is one of your most sensitive controls. Condenser, I suppose?"

"No, Bill," replied his host. "You see, it is like this. I bored one hole too many in the panel, and then put that dial on to hide the hole. It doesn't control anything—except the imagination."

—Geo. F. Noftsker.

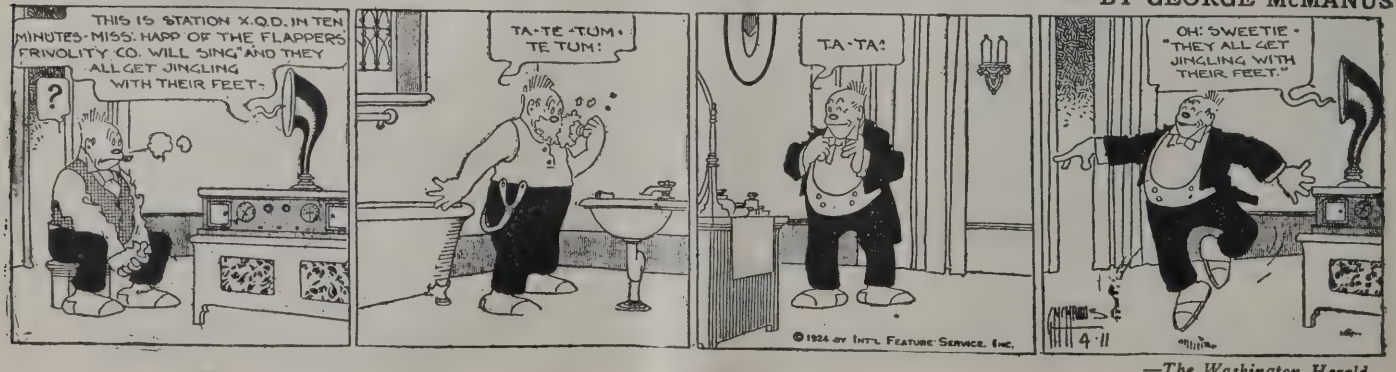
A STRAIN ON THE FAMILY TIE

By Gaar Williams

—*Chicago Tribune*

BRINGING UP FATHER

BY GEORGE McMANUS


THIS IS STATION X.Q.D. IN TEN MINUTES- MISS. HAPP OF THE FLAPPERS' FRIVOLITY CO. WILL SING AND THEY ALL GET JINGLING WITH THEIR FEET-
?
TA-TE-TUM- TE TUM!
TA-TA!
OH! SWEETIE - "THEY ALL GET JINGLING WITH THEIR FEET."
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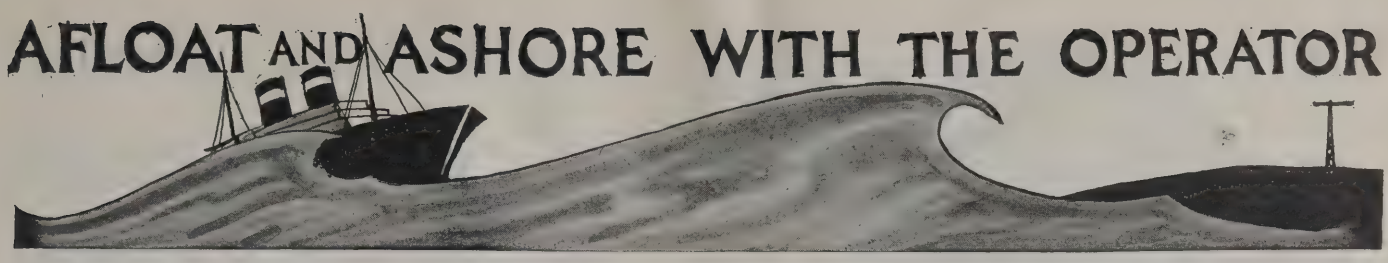
—*The Washington Herald*

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

WHEN the New York office of the United States Shipping Board was opened a wise selection was made in the appointment of Mr. Charles D. Guthrie as radio supervisor. No one could have held this position more creditably or more efficiently; none could have made a larger number of friends and no one could lay claim to greater ability or longer radio experience.

Mr. Guthrie started going to sea as a boy and long before the advent of radio. He was a cadet on the famous school ship *Saratoga,* five years after the graduation of Captain Hartley, now commander of the *Leviathan,* who learned the fundamentals of seamanship on this same school ship.

The *Saratoga* was built in 1842 and was in the fleet of Commodore Perry during the important historic event in opening negotiations with Japan in 1853. The vessel, which carried 24 nine-inch smooth bore guns, was afterward used as a slave chaser and later commissioned as a school ship.

After leaving the *Saratoga* Mr. Guthrie joined the revenue cutter service, now the all-important United States Coast Guard depending almost entirely upon radio, but which at that time had no knowledge of what radio might accomplish. It was only a little over a year previous—November 15, 1899, to be exact—when the American liner *St. Paul* transmitted the first wireless message ever sent from a ship at sea.

In 1904 he enlisted in the United States Navy and after a course at the Brooklyn Navy Yard electrical school was made wireless operator on the battleship *Kentucky.* In use then was the coherer detector with no telephone headsets, the messages coming in on tape. The record distance was 115 miles. Before the end of his naval enlistment head phones came into use and distances of a thousand miles were common through the use of electrolytic detectors.

Mr. Guthrie suggested the use of 1000-ohm phones, but was informed that none over 500 were manufactured and that 500 ohms was the maximum for efficiency!

Some time later the Schmitt-Wilkes phones, forerunners of the Brandes, were made with 1000 ohms resistance and became the Navy standard.

During this period Mr. Guthrie took part in the original radio experiments of the Navy and right here might be conferred the honor of his being the original "Broadcast Listener." It was during the Jamestown exposition in 1907 when it was his duty to listen in on an experiment made by the battleship *Virginia.* The experiment was so successful that daily concerts were given for the benefit of the fleet.

A few years later while an inspector for the Marconi company Mr. Guthrie also took part in broadcasting. On this occasion it was an effort to establish wireless telephone service between the two Wanamaker stores at New York and Philadelphia in addition to the wireless telegraph. So that the listeners at Philadelphia might pick up the signals, Mr. Guthrie would talk until hoarse, then turn on several phonograph records. This experiment was conducted at certain times each day and, while not meeting with the desired success, still brought forth letters and verbal comments from ship operators who enjoyed the concerts considerable distances at sea.

Charles D. Guthrie, Radio Supervisor, United States Shipping Board, as a navy operator twenty years ago and as he looks today

It is not recalled what kind of an announcer Mr. Guthrie made, but he probably had his little jokes and most likely introduced John McCormack to the audience before starting a phonograph record of that singer. It is doubtful however, that he hung up stars over kiddies' homes.

While still in the Navy Mr. Guthrie opened and assumed charge of the first wireless station to be built in Philadelphia. Following his discharge he became a commercial ship operator and five years later was made an inspector for the Marconi Company.

For two and a half years, which included the war period, Mr. Guthrie was chief government inspector of the second district with headquarters at New York. He became Shipping Board radio supervisor four and a half years ago.

* * *

The radio personnel of the large American trans-Atlantic passenger ships is often asked for and, no doubt, will prove of general interest.

The *Leviathan's* radio equipment is in charge of Elmo N. Pickerill of New York and George E. Sinclair, also of New York, is first assistant. The other members of the crew of eight are: Henry F. Bollendonk of Nanuet, N. Y.; Oscar L. Goertz of Brooklyn; Paul W. Karr of Skidmore, Mo.; Earl F. Whiddon of Boston, Mass.; Leslie Veader of Madison, N. J., and Roy W. Jones of Van Wert, Ohio.

H. B. Von Thun is chief operator on the *George Washington;* H. Young is first assistant; H. A. Herring, second, and Ben N. Lazarus, third assistant.

On the *America* Frank E. Black is in charge and is assisted by Arthur Cohen and J. C. Eddy.

The radio men on the new liner *Republic* are Roy Butler, E. J. Girard and N. Moore. On the *President Roosevelt* are W. L. Whitney, C. W. Butt and Louis Brown. The *President Harding* operators are George H. Kolbe, C. Prevetti and Adolph Weik.

* * *

Among the old time operators who are still going to sea is Frank W. Rosenquist, now on E. F. Hutton's yacht *Hussar,* said to be one of the most beautiful yachts afloat and on which is installed the most modern of radio equipment. Rosequist started as a commercial operator in 1912, but had an amateur set as early as 1907. During the war he was in the Radio Intelligence service of the United States Army. (*Continued on page* 88)

A Radio Set for the Summer

How to Build It

Describing the construction of an outfit for automobile camping, the motor boat, or summer cottage which will do as well as sets made only for permanent installation

By M. B. Sleeper
Radio Designer and Technical Publisher

IF you stop to think about it, you'll probably agree that, between summer and winter, radio broadcasting really means more to us in the summer season than in the winter, not only because some of the most interesting things, particularly sporting events, come only with warm weather, but on camping trips or at summer cottages, news is not quickly available in the form of late newspaper editions. Moreover, theatres and concert halls are either closed or at inaccessible distances. Actually, we need radio more, and it is more useful to us, during the summer months, and this year, too, we want radio to bring us the news of the political conventions.

Thanks to the UV-199 tubes, you can have a set wherever you go, not an awkward, heavy affair, loaded with batteries, but a small outfit easily carried. As to the general design of the cabinet and the arrangement of the complete equipment you probably have particular ideas of your own which you want to work out. Consequently, construction data will be given in this article only on the radio set itself.

Figures 1 and 2 show the assembled instrument, consisting of a one-step non-oscillating R. F. amplifier, detector, and two-step A. F. amplifier using UV-199 tubes, while figure 3 gives the wiring diagram. You will see that the antenna circuit is untuned, with fixed coupling to the secondary which is adjusted by a .0005 mfd. condenser. In the plate circuit of the first tube—the R. F. amplifier—is another fixed coupler, or fikit, which acts as a tuned R. F. transformer.

This is in no way a trick circuit. It is an accepted design which has been in use long enough to prove entirely satisfactory as to range, quality, and selectivity. At Darien, Connecticut, we bring in the usual stations, Atlanta, Pittsburgh, Chicago, and Philadelphia with sufficient volume on an inexpensive loud speaker to hear the music and the words of the announcers easily as we sit around the room. New York stations are, of course, quite loud. While the volume is not as great as if regeneration were used, the clearness of the reproduction more than makes up for the lower volume. As a matter of fact you might think, judging by your ear, that you were tuning an amplified crystal set, because there is no carrier wave whistle nor the squeals which come from an R. F. set requiring potentiometer control.

One very important feature, and one which is entirely new, is the pickle bottle inductance. You'll understand, when you read the instructions for winding them, why they are called pickle bottle coils. It is enough to say now that they are wound in a way which makes them self-supporting. Of all types of coils the single-layer winding is most efficient. The efficiency is further increased, or the R. F. resistance lowered, in the pickle bottle coil because no insulating tube is required to support the wire. With all the effort now being spent to reduce the losses in tuning condensers, this is the first improvement on small-inductance coils which has been brought out in several years. In this connection it is interesting to note that the R. F. resistance of a spider web or basket wound coil is greater, for a given inductance, than a single-layer winding on a bakelite tube. The only type of coil having any lower losses is the single layer winding without a tube.

Information concerning the losses of spider web coils has been in possession of some of the commercial companies ever since 1917, when English army outfits, equipped with that type of inductance, were sent here to be reproduced by American manufacturers. Experimenters, however, still cling to the mistaken notion that they have lower losses than the single-layer coil.

But to get back to the set itself—the front panel is of 3-16 in. bakelite,

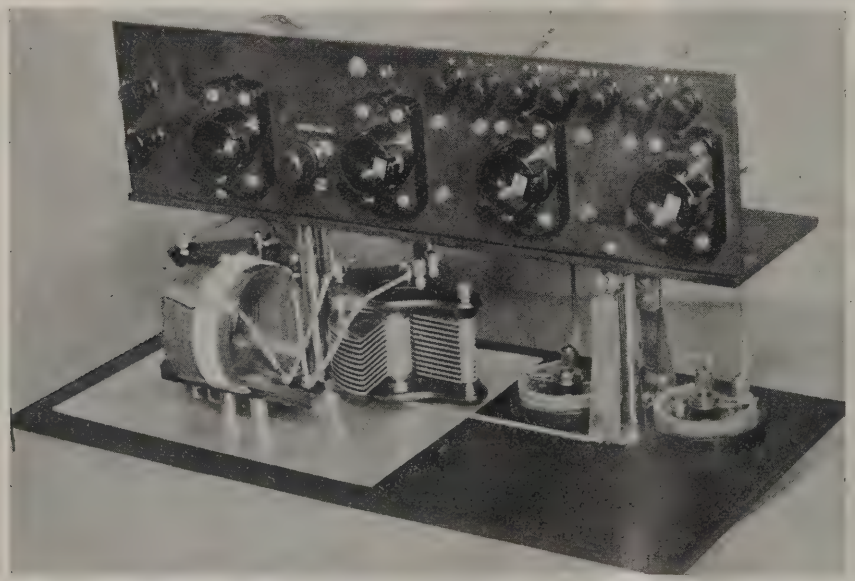


Figure 1—The portable receiver assembled. Showing the tube panel and the reverse of the front panel on which one of the R. F. pickle-bottle transformers is mounted

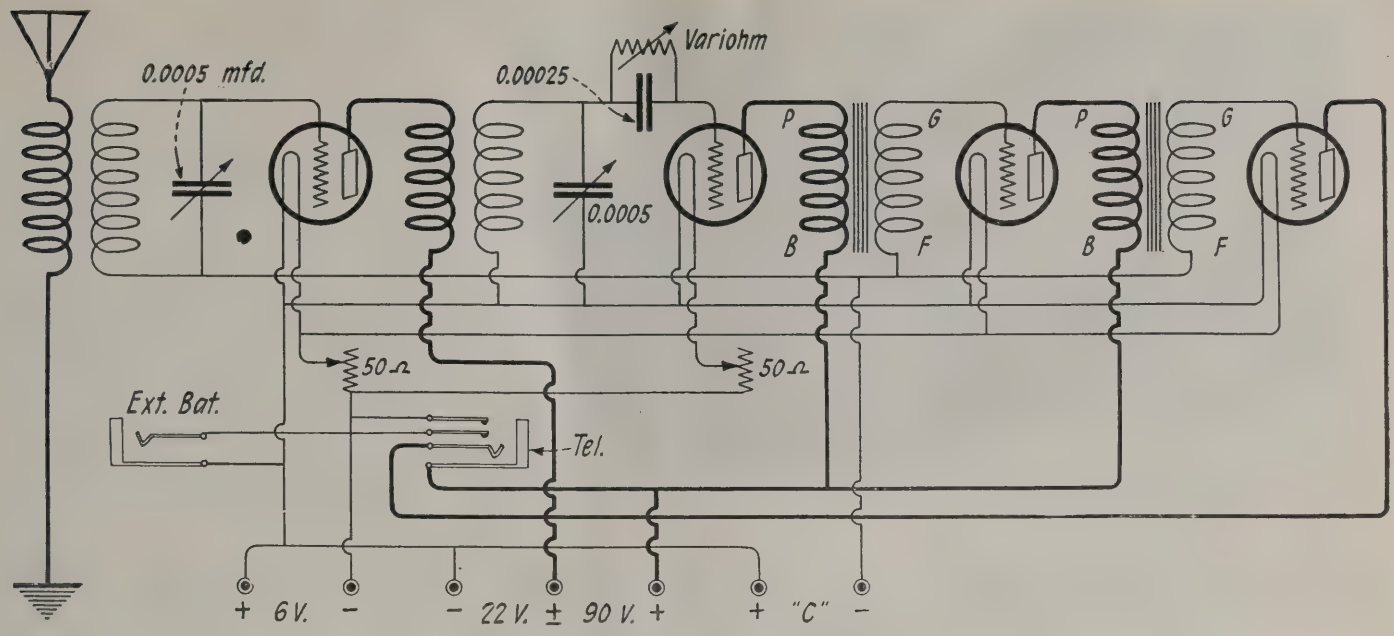


Figure 2—Wiring diagram of the portable receiver

measuring 7"x14". At the rear, supported on nickeled brass pillars ⅜"x3⅜" long, is a vertical sub panel to which a tube panel is secured. Both measure 13"x3½"x3/16". This is a very handy arrangement as it allows the tubes and transformers to be mounted behind the variable condensers, and permits them to be arranged in less space with shorter connections than if a base panel were employed.

Figure 4 gives the dimensions of the three panels. Notice that all holes are made with a No. 18 drill except the 15-32" holes for the rheostats, condensers, variohm and jacks. Four countersunk holes are made in the tube panel for the terminals of the Ark transformers. The countersinking is necessary because the terminal screws are a little short to go through a 3-16" panel.

If the drilling is changed slightly the parts from any of the reputable manufacturers can be used, but if you want to reproduce this set exactly you will need two General Instrument .0005 mfd. condensers, two 50-ohm Amsco rheostats, two 3" and two 2" Kurz-Kasch dials for the condensers and rheostats, and open circuit filament control Carter jack, four General Radio UV-199 sockets, an Electrad Variohm, a .00025 mfd. Micadon, two Ark transformers, and nine Eby binding posts. The cost of all these parts, including the screws and fittings, comes to less than forty dollars.

In addition to the items mentioned, you must have the two pickle bottle inductance units. Get a ¼-lb. spool of No. 24 S. S. C. and one of No. 20 D. C. C. wire, some gummed paper tape such as is used for fastening bundles, and two pickle or preserve bottles 2¼" in diameter, of eight to fourteen sides. If you can't get them of polygonal cross section, round ones will do. Cut four lengths of the tape ¼" wide and 6" long.

With someone to hold the spool of No. 24 wire for you, clamp the bottle between your knees, fasten the end of the wire by several turns around the neck of the bottle and bring the wire up onto the straight part. Turn the bottle and wind the wire over the strips, placing them ninety degrees apart. Moisten the tape as you go. When you have put on 70 turns, cut off the ends of the strips so that they stick out 1½" on each side of the coil, wet them, and bend them over on the wire. Thus the tape will hold the turns securely every ninety degrees. Cut the end of the wire.

Put on the primary winding, of No. 20 wire, in the same way, using four shorter strips of paper. Six turns are required, wound on top and at the center of the secondary. This coil completed, break the bottle and remove the pieces of glass carefully so as not to cut the insulation. You will then have a surprisingly strong, self-supporting inductance unit.

To mount it, cut out two 3-16" bakelite strips 3¼" long and ½" wide. Drill two holes in them at each end for screws to hold the strips together and to act as primary and secondary terminals. In addition, drill two holes 1" apart and countersink them, in one strip. They are to take screws threaded into brass pillars ¾" long by 5-16" in diameter which serve to mount the complete fikit under the tube panel. Put the coil between the bakelite strips and tighten the end screws with nuts.

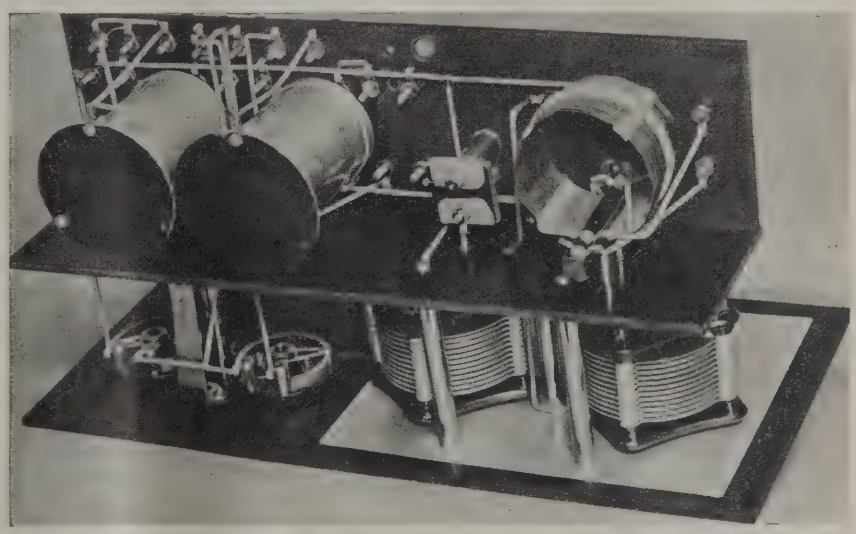
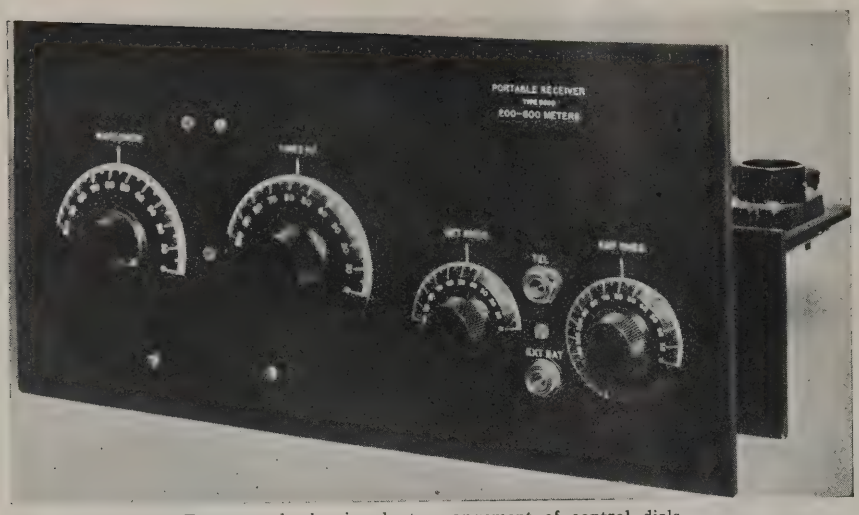


Figure 3—The assembled receiver, showing under side of tube panel on which the A. F. transformers and one of the R. F. pickle-bottle transformers are mounted



Front panel, showing best arrangement of control dials

Make another fikit to be used as the R. F. transformer in the same way, but put 12 turns on the primary.

You also need two angle brackets to fasten the tube panel to the sub-panel. They are 1" lengths of 3/8" angle brass, one with a No. 18 hole in one leg 3/8" to the right, and one 3/8" to the left of a hole in the other leg. The brackets, panel support pillars, and the coil mounting pillars are stock items which you can buy if you do not want to make them up.

Mount the instruments on the front panel and do as much of the wiring as you can. Then fasten the other parts to the tube panel, and connect them as far as possible. Notice that the socket connections must be changed. Take out the contact spring screw and put in its place a 1" 6-32 R. H. screw, with the head on top of the socket base. Replace the spring, and clamp it with a nut. Repeat this process at each terminal. The sockets are held to the panel by nuts on these screws underneath. Moreover, connections are in this way made under the panel as you will see from the illustrations.

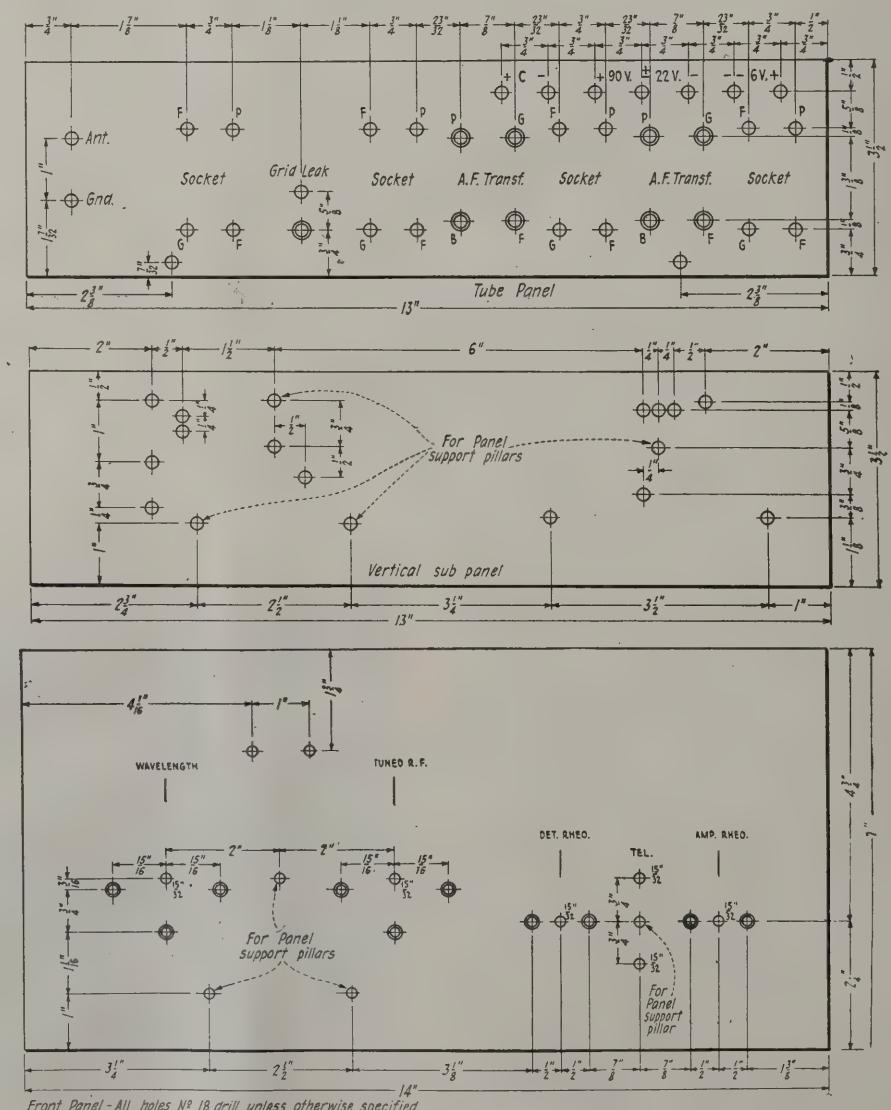
Finally, mount the sub-panel and fasten the base panel to it; then the last of the wiring can be done. Holes marked X on the sub-panel drawing are to take wires connecting instruments on the front panel to those on the tube panel.

There is a wide choice of batteries available. The lower jack on the front panel is provided so that you can plug in a connection made in place of the dash light on a motor car. Rheostats of 50 ohms are specified to take care of a 6-volt "A" battery. Dry cells can also be used for filament lighting. Three 6", dry cells, operated 2 to 4 hours a day, will run the filaments over 100 hours. Six cells in series parallel giving 4½ volts, will last more than twice as long. If weight is an important factor use four of the Eveready type 3 batteries in parallel. They will last about 25 hours.

If you are going to use telephones a tapped 45-volt "B" battery, preferably the large size, is enough, but 90 volts will increase the volume greatly. The small 22½-volt "B" batteries are all right for a few weeks though the big ones stand up much better. In addition you must have a 4½-volt flashlight battery or Eveready type 3 for the "C" battery. This is important for it improves the quality considerably and makes the "B" batteries last much longer.

Since the primary circuit of the set is untuned you can use almost anything for an antenna. A wire fence is good, a tin roof, or the frame of an automobile. For portable use you can throw one end of a 100-ft. length of bell wire tied to a weight up into a tree. On a motor boat use two wires three feet apart, run from the bow to the cross arm and down to the stern. Ground connection can be made to a tin can dropped into water, the pump pipe, a nail driven into the roots of a tree, or, on a boat, to a metal plate under water.

Once you have learned the approximate settings for the condenser dials, you can tune in very quickly. The settings will not change no matter what kind of an antenna you use. Both dials must be rotated slowly at the same time.



Dimensioned drawings of the three panels. Note that the tube and vertical sub-panels can be made by sawing a regular 7-inch panel in two

10,000 Boys Wanted

A Job Open on The Wireless Age Staff for Every Youngster Who Wants a Radio Set or Parts to Add to the Set He Now Has

BACK in 1910, the writer, then a youngster, borrowed some books from the library in his midland home town, and set about to build a radio set. At that time, however, very little was known about radio. None of the dealers carried parts in stock. In fact, that youngster had a great many obstacles in his way—even the older folks laughed good naturedly at his "notion."

But the notion persisted. That youngster wanted a radio set. And have it, he would.

One day he found a catalogue, listing a great many parts, but parts that cost too much money for an allowance of fifty cents a week. There was but one thing to do—carry newspapers. And that job brought in one dollar and fifty cents each week.

Those of you who are reading this story will know at once that on a small income of $2.00 a week a great deal of scheming and patience was needed to accumulate enough money for a full-fledged receiver.

After the set had been completed and used for some time, the youngster's ambition turned to audion detectors and other better parts. He got joy out of every improvement made. And he always wanted to improve his set still further.

The difficulties once conquered, left that youngster with one resolution—that some day he would make it easy for other young chaps to get the parts with which to build a radio set.

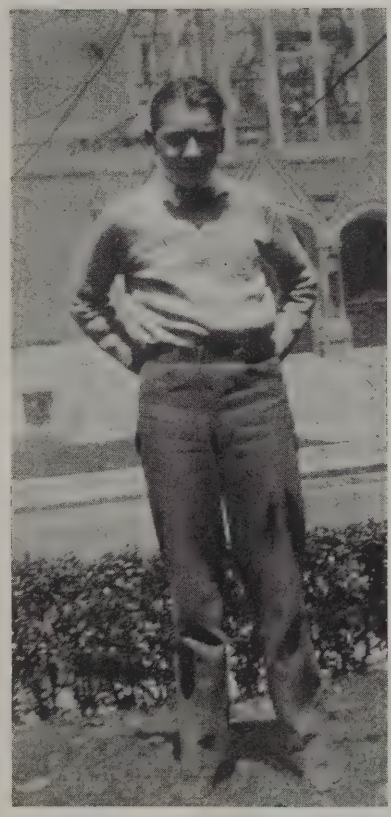
And that resolution has been realized! Read the following—it tells you how!

* * *

I want 10,000 young men to join the staff of THE WIRELESS AGE. Each one will be well paid. And this is how you join:

Write a letter to the Boys' Editor. Tell me whether you want a complete set; parts to go with a set you now have; or just what you do want.

Then tell me where you live and how old you are. Tell me anything else about yourself that you think I would like to know.



Bobby Carmighael, Durham, North Carolina. Bobby is an enterprising salesman on THE WIRELESS AGE staff, making good under our careful guidance. He will have his radio set earned in a very short time

And this is what I will do for you:

I have 35,000 names of people who have bought radio sets. Each one of the 35,000 will like to know more about THE WIRELESS AGE. Some of those people, in fact, have been taking the magazine, but forgot to renew their subscriptions. Those 35,000 people live in every part of the country. Some of them live in YOUR town or city.

When I have received your letter telling me what you want in radio, I will write to you and tell you how many subscriptions you must get in order to earn what you want. Even ONE subscription will get you a radio part.

And this is why you can get subscriptions—I am going to teach you HOW TO SELL. Then I am going to give you, from the 35,000 names I have, a list of those who live in your locality. In that way you become a salesman for THE WIRELESS AGE, with a calling list of people who own radio sets and, of course, will want a radio magazine. I have sent a letter to each one of the 35,000 so that they will know about THE WIRELESS AGE even before you call on them.

I now have a good many on the magazine staff earning their radio sets. None have failed to make good! And the reason is that I have wanted to make good myself and I now intend to see all the others make good.

Write to me NOW. Address your letter to the Boys' Editor, THE WIRELESS AGE, 326 Broadway, New York. Tell me just what you want most.

If you have a pal or two, write together. Sometimes team work is better than alone. But write to me at once.

—Boys' Editor.

A Steady Job for Enterprising Boys

WRITE to me. I will teach you how to sell subscriptions, supply you with samples, give you a calling list, and then send you out as a full-fledged salesman. A credit account will then be established in YOUR name. You can draw CASH from that account or get what you want in radio parts at WHOLESALE PRICES—just as you like. But in addition to this, I will give a Paragon RB2 $135.00 Receiver for first prize, a Thompson (Magnaphone) $35.00 Loud Speaker for second prize, and a N & K $8.50 Headset for third prize, to those who secure the most subscriptions between JUNE 15th and SEPTEMBER 15th. The prizes will be given in addition to what you receive for the subscriptions. If you win a prize your subscriptions will bring you cash or radio parts just the same. You are paid for your subscriptions even though you don't win a prize! That is because you will be a paid member of The Wireless Age Sales Staff!

—Boys' Editor.

Chasing Squeals

How to Get Better Results From Your Receiver

The first installment of this series of radio-trouble correctors was devoted to receiver noises; this month receiver-squeals are treated and next month the author will tell how to discover what's wrong with a "dead set" that gives no signal

By R. A. Bradley

DURING the last year or two, the public has undergone a stage of transformation or we might say reform in which time their sentiment toward Radio has become in some cases enthusiastic, in some cases tolerant and in other instances has become a radical dislike and opposition. Of this last class there seems to be two sub-divisions: those that are waiting patiently for Radio "to perfect itself," before partaking of any of its benefits—they acknowledge that there are benefits to be had from it—and then there are those who have had the misfortune to hear, in some friends home, a misguided radio set or in some radio shop where the sets are tuned by guess work or left to suffer or work out their own salvation, which incidently they never can do. To these unfortunate people, radio has presented its worst side and they have been turned against it, believing that the terrifying squeals and noises issuing from the mouth of the loud-speaker constitute a normal and ever-present condition. This is not true. To these we have dedicated this article in the hope that they will be convinced partially or totally that the foul and uncouth noises and whistles which they have heard are remediable, and not an existing condition in a properly built and properly operated receiving set. Also, this is written to aid the man who has already delved into the subject and who has bought or built a receiver and who is disappointed or is ready to give up in disgust..

Rev. Francis Duffy O'Laughlin, S.J., Ph.D., is head of the Department of Physics at Fordham University, which possesses the fine receiving equipment here shown. Father O'Laughlin teaches his classes how to tune properly to prevent squeals

IN LAST month's issue of THE WIRELESS AGE we described receiver noises, analyzing them; showing how to connect up the noises with difficulties in the receiver and in general how to eliminate them entirely. This month we are turning our attentions to another source of discomfort and annoyance—squeals. We defined noises as being anything in the form of sound which come out of the loud speaker or head phones which could not be classified as any note on the musical scale. Thus, we have brought about the definition of squeals as being sounds which were more or less musical even though they lacked harmony and seemed far away from anything which could be called musical.

SQUEALS are almost invariably due to the operation of the set, rather than to any real fault in the receiver itself. We can subdivide the squeals into three different classes. Probably the most common squeal is that due to a regenerative receiver in the hands of an inexperienced or uninformed operator. On most regenerative receivers there are two main features of adjustment, two dials which control the tuning in of a station. One of these is the wave length control which may be either a variable condenser or variometer somewhere in the secondary circuit. The other is the means of obtaining regeneration which may be the rotor coil of a variocoupler or a variometer inserted in the plate circuit. Major Armstrong some time ago discovered that if the plate circuit of a vacuum tube was tuned and brought into approximate resonance with the secondary circuit, a peculiar phenomenon took place which greatly amplified the changes in the grid voltage brought about by an incoming signal.

WHEN you tune your set, you set the wave length dial at approximately the position where a station should be received and then bring up the regeneration dial which as we said before may be the rotor of your variocoupler or a plate variometer until the signal is brought in loud and clear. We have said this is the way you do, but we should have said, this is the way you ought to do. In hunting for distant stations the inexperienced operator throws his set into a state of oscillation and then turns the wave length dial until he hits the squeal of a distant station. He then retracts his regeneration dial until the speech or music is cleared up. Much has been written on how annoying this is to neighbors who are listening in also, but the situation has not improved. When you pass over a station to which a neighbor is tuned, you set up in your neighbor's receiver a disagreeable squeal which varies in pitch from very high to very low and then up again.

A LITTLE experience in tuning your receiver will enable you to turn both the wave length dial and the regeneration dial at the same time keeping your regenerative dial at such positions that your set is at this sensitive point. It is perhaps somewhat harder to locate a distant station by this method at the start, but a little experience in tuning properly will not only make your neighbors feel more kindly toward you, but will likewise enable you to hear more distant stations. There is another source of squeal in a regenerative set and that is the grid-leak. Experience has shown us that the average man slams a two megohm gridleak into his set and proceeds to forget it. Now in a good many cases two megohms is the right size grid-leak for the average hard vacuum tube detector on the market today, but in as many instances or more, two megohms is not the right size for your particular tube. For example, when a regenerative receiver goes into oscillation with a plop and bang over, you can be very sure that your gridleak is of the wrong size. Then, too, as your set goes into oscillation any way or in any fashion except smoothly and gradually you can be certain that your gridleak is wrong. Very often receiving sets in a state of oscillation do not even squeal, but have a steady plop occurring at regular intervals.

This is another indication of an improper gridleak.

Rules cannot be set down for the size gridleak to be used with your set, as conditions in different sets vary with each individual tube. For instance, the writer has used a UV-200 as a regenerative detector for about three years. He has never found it necessary to use any gridleak at all. The leakage in the socket and in the mountings and in the various instruments themselves proved sufficient for the purpose. However, in the same receiver when using a UV-201A it was found impossible to get satisfactory results except with a 1½ megohm gridleak. It is well to have on hand values of ½, 1, 1½, 2, 3 and 5 megohms so that the proper size may be determined by experiment. If you have a variable gridleak that is a good one, which is not subject to temperature changes, the need for this assortment will be obviated. That finishes up gridleaks and regenerative sets.

We will next take up the squeals which are sometimes present in tuned and untuned radio frequency receivers. In a tuned R. F. receiver squeals mean one thing and that is that the means of neutralization of the stray capacities and of the interstage coupling, is out of adjustment. Whatever is the means of neutralization—mounting the transformers at angles around 54 degrees, or neutralizing condensers, they are not correctly adjusted. If your receiver is a manufactured product it should be returned for complete neutralization. If you have made it yourself there are certain methods of procedure which we will outline here. A signal should be tuned in as loud as possible, the filament turned out on the first R. F. tube leaving the tube in the socket. The first neutralizing condenser should then be adjusted, until the signal is disminished to its greatest extent. This same procedure should be followed with the second R. F. tube. If the neutralizing condensers are the proper size this will bring your set to complete neutralization and no further difficulties should appear. If the neutralizing condensers do not seem sufficient then attention must be paid to the angular mounting of the transformers and these transformers adjusted until complete neutralization is accomplished. If, however, you have an untuned radio frequency receiver such as the many types of reflex sets now on the market, howls or squeals in one of these means that the radio frequency amplifier is oscillating.

Don't Shout

about your receiver troubles. It's your own fault if you have them. They can all be corrected.

This is the second of a series of articles designed to show our readers how every manner of radio receiver trouble can be remedied. Last month's article was devoted to noises in your set—all kinds of noises, and told you how to get rid of them. Here you are informed how to eliminate the annoying squeals. Next month you will learn what to do when your receiver fails to give any signal at all. Make your receiver give you full value!

UNTUNED R. F. RECEIVERS

There has been a harmful theory floating around that the placing of a stage of radio frequency in front of an ordinary regenerative receiver will eliminate re-radiation. This is true only when the radio frequency amplifier is not oscillating. Radio frequency amplifiers in an oscillating condition can radiate just as powerfully and just as annoyingly as the worst regenerative receiver in existence. In most of these receivers there is a potentiometer sometimes caller "stabilizer" across the "A" battery. This potentiometer controls the negative and positive grid bias, on the radio frequency tubes. In turning this potentiometer from one extreme to the other a point is passed where the receiver is in its most critical condition, the same as a regenerative receiver. Past this point the amplifier breaks into oscillation and is quite useless and likewise harmful. The adjustment on this potentiometer varies with the wave length control, and no set position can be predetermined.

Next we come to a different variety of squeal which can be more properly termed a howl. This howl does not vary in pitch and is somewhat of a musical note, generally very, very high. The cause of this is usually in the audio frequency amplifier. There are very few shielded audio frequency transformers on the market and those that are not shielded have quite large magnetic fields surrounding them. When two such transformers are placed close together or end to end there is a coupling formed between the magnetic fields and the result is an audio frequency howl. This can be done away with by moving the transformers farther apart or by placing one at right angles to the other. If this does not eliminate it the trouble may lie in the ratio of turns in the transformer windings. You may have a low ratio in the first step and a high ratio in the second step which is the reverse of the way it should be. However, we have used as many as three stages of audio frequency amplification employing high ratio transformers in all three steps and placing across the secondary terminals of each transformer a 1-10th megohm leak.

This leak cuts out all "set noises" and squeals which were present when the leak was not employed. It was also found that by shunting the secondary of each transformer with an .001 mfd. fixed condenser in place of the gridleak the same result was brought about. We do not advise, however, the use of more than two stages of audio frequency amplification.

We mentioned in a previous paragraph how your set might be manipulated to the annoyance of your neighbors, but we did not mention what to do in case your neighbor annoyed you for the very good reason that we don't know. The best thing that we can offer in this instance is to locate the offender and show him how to tune his set. There is one source of squeal which may be in most any set and which comes under none of the previous headings and that is the one which is due to too high filament current. This is probably more noticeable with dry cell than with storage battery tubes. We know of several owners of radio sets who when they turn the set on whirl the rheostats clear over to the limit in order to get more "noise" out of the set, and that is exactly what they get.

(*Continued on page* 82)

Continuing a Summary of the Entire Subject of Amplifiers

Amplifiers

With proper design great amplification can be obtained in several ways without distortion

By Louis Frank

PART II

Multi-Stage Amplifiers
Resistance Coupled:—Audio and radio frequency.
Impedance coupled amplifiers:—Choke Coils.

Part III will follow in next issue

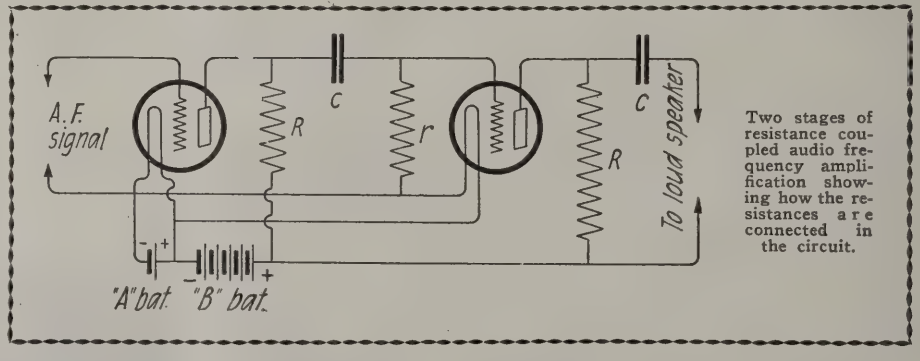
IN the first part of this article published in the May, 1924, issue of THE WIRELESS AGE we considered the cases where a single tube amplified the energy input. When a number of tubes are placed in cascade, the amplified output being still further amplified by the succeeding tubes, we have a multi-stage amplifier. Assuming properly designed circuits, enormous amplifications may be secured. For supposing each tube and its circuit gave an actual amplification of 10 times, the received signal would be amplified 10 times by the first tube, the second tube would amplify this increased signal 10 times more, making an amplification of 100 and so on. The great possibilities of multi-stage amplifiers becomes apparent.

In the multi-stage amplifiers any of the systems described for single stage amplifiers may be used. Thus we may have multi-stage resistance, inductance, transformer and tuned circuit amplifiers. These in turn may be used for either radio or audio frequency amplification, and the design will depend upon which is used. In many cases it will be found that the radio frequency amplifier is more difficult to build for reasons which will appear later. But the radio frequency amplifier has some important advantages. In the first place it should be observed that the detecting action of vacuum tubes is proportional to the square of the radio frequency voltage applied to it. Hence a radio frequency amplifier which will increase the magnitude of the radio frequency voltage before it is applied to the detector tube will be of great assistance in increasing signal intensity. Radio frequency amplification of one sort or another is quite essential for long distance reception, in order that the very weak radio frequency signal may be amplified sufficiently to actuate the detector tube efficiently. On the other hand, audio frequency amplification will be found to be essential if loud speaker operation is to be secured. The limiting features of both these types of amplifiers will be described in the course of the article.

Radio Frequency amplification brings distance

MULTI-STAGE RESISTANCE COUPLED AMPLIFIERS—AUDIO FREQUENCY

A two-stage resistance coupled audio frequency amplifier is shown in figure 1. By adding more tubes in the same way this may be made a three-stage, or any numbered stage amplifier. The audio frequency signal to be amplified is applied to the grid of the first tube. This audio voltage is repeated in the plate circuit of the first tube and an amplified voltage appears across the plate resistance R. This amplified voltage is then applied to the grid of the second tube through the grid condenser C1, and the voltage amplified still further by the second tube, and so on.



Two stages of resistance coupled audio frequency amplification showing how the resistances are connected in the circuit.

In each case it will be observed that a grid condenser is necessary even though rectification and detection are not the objects of the tubes. The reason for the grid condensers is to prevent the high positive potential of the plate battery from being impressed on the grids of the tubes through the plate resistances, thus avoiding damaging the tubes. Such a condenser is called an "isolation" condenser, it isolates the grid from the plate battery supply. Since these grid condensers are required it also becomes necessary to use grid leaks (r). For unless these are used the negative charge accumulating on the grids will have no means of escape, and will thus reduce the plate currents to zero and block the operation of the tubes. As soon as one step or a multi-stage amplifier is blocked the entire amplifier becomes inoperative. The grid leak functions in discharging this negative potential, thus permitting the operation of the amplifier.

The values of plate resistances required in multi-stage amplifiers are determined by exactly the same conditions as for the single stage amplifier described in the May issue. For practical results the plate resistances should be several times the internal impedance of the tube. Since the tubes used in a multi-stage amplifier are usually alike the plate coupling resistances used for the different stages are also the same.

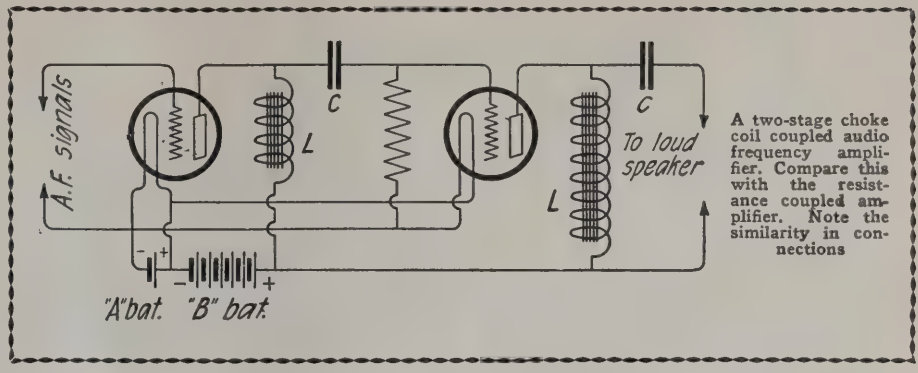
Inasmuch as the plate impedance of amplifying tubes as designed today is of the order of 20,000 ohms, the plate coupling resistances used should be about 60,000 ohms or over. These resistances must satisfy certain conditions if good results are to be secured. In the first place, the design of the resistances must be such as to have a minimum distributed capacity. For since this distributed capacity is in parallel with the resistance itself, it will result in reducing the impedance of the coupling resistance, and hence also in reducing the amplification. In the second place the plate coupling resistance carries the entire plate current. It must therefore be able to handle the amount of energy dissipated in it without overheating and changing its resistance. For the change in resistance will again result in alteration of the amplification. But worse than that, if the resistance alters regularly

with the passage of current through it, there will simultaneously result a change in current through the resistance, with the bad feature that noises will be heard in the phones. Crackling, hissing and irregular noises are often due to poor plate resistances which vary in magnitude. The standard tubular resistances and lavite resistances have proved to be satisfactory for this work.

The proper values for the grid condensers and leaks are determined by definite considerations. If figure 1 is examined it will be seen that the grid circuit of the second tube is in parallel with the plate coupling resistance of the previous tube between points A and B. The impedance of the entire grid circuit must therefore be much greater than that of the plate resistance in order that the amplification be not influenced. The impedance of the grid circuit is determined by (1) the impedance of the internal grid-filament path of the second tube, and (2) by the impedance of the grid condenser and leak circuit. The impedance of the grid-filament path inside the tube is determined by its capacity and resistance. In general, as tubes are made today, its capacity is so low as to make its reactance greater than a million ohms at speech frequencies, and its resistance is of the order of a few hundred thousand ohms. Hence the impedance of the grid-filament path of the tube is seen to be sufficiently great not to influence the amplification at audio frequencies. The impedance of the grid leak circuit is dependent on the leak mostly. This is usually of the order of a few million ohms, and hence will have no effect on the plate resistance and amplification. Since the voltage across the plate resistance R is applied to the grid of the succeeding amplifier tube through the grid condenser C, the reactance of this grid condenser must be so low compared to the plate resistance that it does not alter the voltage applied to the grid, for any voltage consumed by this condenser means that much less to be amplified by the succeeding tube. Reasonable values for this condenser are found in practice to be about 0.1 to 1 microfarad, the larger the better. Thus for a 1 microfarad condenser the reactance at 1,000 cycles is about 160 ohms, which is seen to be negligible compared to the 60,000 ohms for the plate resistance R, and therefore there will be no voltage lost in this condenser.

Resistance coupled amplifiers distortionless

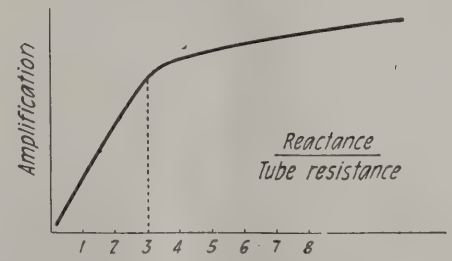
The disadvantages of the resistance coupled amplifier were explained in the first part of this article. The resistance coupled amplifier has, however, one very great advantage for broadcast purposes. It gives uniform amplification over the entire audio frequency range, hence it is a distortionless amplifier. It gives better quality speech and music than most any other type of amplifier.



A two-stage choke coil coupled audio frequency amplifier. Compare this with the resistance coupled amplifier. Note the similarity in connections

Radio Frequency

The same type of circuit and the same considerations apply for radio frequency amplifiers as for audio frequency amplifiers. But there is one great difficulty with radio frequency resistance coupled amplifiers at low wave lengths. The impedance of the grid-filament path of the tube is so low that it practically short circuits the plate coupling resistance, and hence destroys all amplification. To illustrate with a numerical example, suppose that the plate resistance R in figure 1 is 60,000 ohms. In present day tubes the tube capacity is of the order of .000010 microfarad, and at 300 meters the reactance is about 16,000 ohms. These 16,000 ohms are in parallel with 60,000 ohms plate coupling resistance, and therefore the effective plate impedance is decreased to less than 16,000 ohms with the result that amplification is considerably reduced. This effect is greater as the wave length decreases. Thus resistance coupled amplification at low wave lengths is not feasible. At the high wave lengths it becomes more possible because the reactance of the tube capacity is not so low. It is therefore recommended that this type of amplification should not be used at radio frequencies at the broadcast or amateur wave lengths.



Graphic picture of the amplifying action of the vacuum tube

Multi-Stage Impedance Coupled Amplifiers—Audio Frequency

A two-stage audio frequency amplifier, inductance coupled, is illustrated in figure 2. It is similar in appearance to the resistance coupled amplifier previously described, the only difference being that iron cored inductances are used in place of resistances to couple the different stages together. The grid isolation condenser and the grid leak should have the same values as for the resistance coupled amplifier mentioned above.

The amplification obtained with such a system depends upon a number of factors. In the first place it depends upon the value of the choke coil or inductance. Figure 3 is a curve which shows how the amplification depends upon the reactance of the inductance and it is seen that practically maximum amplification is secured when the reactance is about three times the internal resistance of the tube. Hence the iron core choke must be made large enough to give this value, when full amplification is had. Now the reactance of the inductance depends upon the frequency. Therefore, in the second place, the amplification depends upon the frequency. The reactance of an iron core inductance increases with frequency, therefore at the lowest frequencies it is possible that the reactance may be much lower than is required to give full amplification. At the higher frequencies the reactance will be greater, hence full amplification will be secured at the higher frequencies. Thus we will have non-uniform amplification of the low and high frequencies, which is bad for it introduces distortion.

This is largely the trouble with all audio frequency choke coil amplifiers; unless they are properly built they readily distort. This may be avoided, however, by a consideration of the principles here outlined. If the inductance is made sufficiently great so that its reactance at the lowest audible frequency, say 50 cycles, is about three

(*Continued on page* 86)

Condensers — How to Choose the Right One for Your Circuit

By Donald Gordon Ward
Associate Member, Institute of Radio Engineers

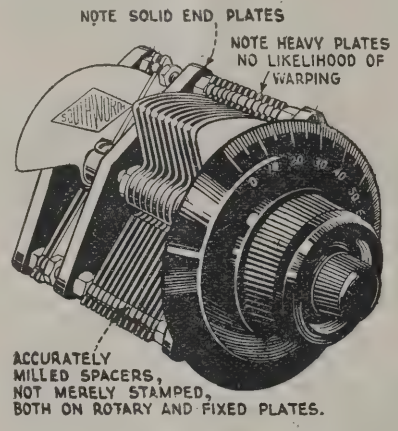
PART 1

NO attempt will be made in this series of two articles on the subject of condensers to say that any particular variable condenser is any better than any other variable condenser, but on the other hand the various factors which enter into the construction of a condenser will be pointed out and it will be then left to the individual purchaser as to the make of condenser which he will choose.

Any attempt to point out the very best type of variable condenser on the market and then to say that only this condenser should be used would lay the one who had made the statement open to a great deal of ridicule, for as there are all grades of condensers on the market at the present time so are there all types of construction in radio receivers. We have variable condensers which are subject to many defects not present in the best grade of condensers and so there are many receiving sets which have defects not present in other receivers. It would be a foolish waste of money to put a variable condenser of the best grade of construction and having the smallest amount of losses into a receiving set that had poorly constructed coils and was wired in a haphazard fashion and also it would be a senseless procedure to burden a finely constructed receiver with a variable condenser which has a large number of losses of various kinds.

Therefore after the reader has decided to construct a receiver let him then decide just about how much money he has to put into a receiver and then he will be better able to decide just what he should purchase in the line of condensers for his outfit.

In this the first of the series of two articles on condensers no attempt will be made to give any exact data on condensers, but more attention will be given to pointing out the general condenser principles while the second article of the series will treat with some of the more exact condenser details which must be taken into consideration when one wishes to be extremely precise and accurate in his receiver construction in order to have, as a finished product, a receiving set which is as fine a one as he can construct. One very excellent measure of the quality of a condenser lies in its price, for the rule holds true in radio as well as in any other, that the purchaser gets just about what he pays for, and while there are occasionally real bargains in radio parts, most generally if one pays a small price for a piece of apparatus he gets something which is only worth what he pays for it, and even sometimes he does not even get as much as that, because even though to the average broadcast fan a variable condenser looks like a variable condenser, mere looks does not enable the purchaser to judge as to the working qualities of his purchase.


NOTE SOLID END PLATES
NOTE HEAVY PLATES NO LIKELIHOOD OF WARPING
ACCURATELY MILLED SPACERS, NOT MERELY STAMPED, BOTH ON ROTARY AND FIXED PLATES.

Range of Capacity Is Important

One of the first determining factors which concerns the home radio constructor is the capacity of a condenser. What is its maximum capacity and what is its minimum capacity? There are two elements which enter into the construction of the radio frequency circuit, and capacity is one of them. Even if the amateur constructor does not know how to calculate the wavelength of his circuit from the inductance and capacity which it is going to have, still he should know what the capacities of his condensers are supposed to be, as it is the range of his capacities which determine the wavelength range over which he will be able to receive. The average diagram which is to be followed by the one who "builds his own" contains the maximum capacity values of the condensers to be used.

A practice that has been followed in the past and is still being followed by some manufacturers is to classify their condensers according to the number of plates in the condenser, but that is no indication of the electrical dimensions of the condenser, which is what one really wants to know. For example, there are two condensers lying at the right hand of the author while he is writing this article. They are both of the so-called 23-plate variety and the capacity of one is almost double the capacity of the other, yet according to the number of plates used they are exact duplicates. The root of this trouble lies in the fact that a great number of condensers are made by concerns who have simply taken a variable condenser and copied it without any regard to its electrical dimensions, probably for the very sufficient reason that they themselves do not know the meaning of capacity and its effect in electrical circuits, but of course in time they will learn and gradually their products will improve in quality and then they will mark their condensers with their electrical values. This will not come, however, in many cases until the public begins to demand that the capacity of condensers be noted on the condenser as is the case in the better grade of apparatus.

It is not an expensive procedure for the manufacturer to do this, and does not work any hardship upon him, while on the other hand it does tell the constructor definitely whether that particular condenser will fulfill his demands or not.

Number of Plates Means Little

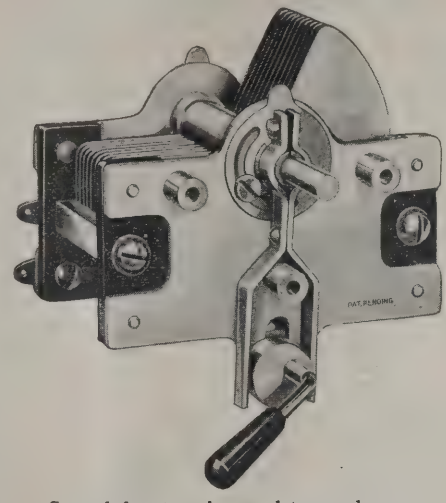
This matter of the public merely designating a variable condenser according to the number of plates it employs may be exactly compared to the man who, wishing to purchase a suit of clothes, walks into the nearest clothing store and says that he wants a blue suit. The clerk hands him the first blue suit without looking at the size of the suit and the man merely says, "Wrap it up." He would make a sorry sight to say the least if he had purchased a suit of clothes which was made for a man of greater size than himself, but he would not look any worse than would his radio set, if he should buy a variable condenser of any old size, electrically speaking. It must be remembered that there is no relationship between the electrical and mechanical dimensions of a variable condenser, and that while two condensers may have the same number of plates and these plates may be of the same size, yet if the spacing between the plates differs by even a slight amount, such as a hundredth of an inch, the capacity will be radically affected.

Another dimension which is just as necessary to have upon a variable condenser as its maximum capacity, is its

minimum capacity, for it is the minimum capacity value of the condenser which determines the minimum wavelength to which the circuit will tune. It is the usual practice for one who wants a circuit that will go down to the lower wavelengths used in broadcasting to purchase a small sized variable condenser. Suppose for example that the maximum capacity is known to be .0005 microfarad. What does this tell about the minimum wavelength to which this circuit will tune? Absolutely nothing. For the minimum wavelength is dependent upon its minimum capacity which should not be greater than 10 per cent. of its maximum capacity in a properly constructed condenser, but which very often will run as high as 20 per cent.

MINIMUM AND MAXIMUM CAPACITY RELATION

A condenser with the 10 per cent. minimum will permit the circuit to be tuned down to approximately half the wavelength value which may be reached by the circuit having a condenser of 20 per cent. minimum. The following table of three sets of values was made of three condensers of different makes and illustrates the difference in electrical dimensions.



Grounded rotor, brass plate condenser

Max. Cap.	Min. Cap.	Per Cent. Min. of Max. (approx.)
.002	.00006	3
.0005	.0001	20
.00035	.000018	5

As will be seen from these figures the first condenser with its very high maximum of four times that of the second condenser will be able to reach a lower wavelength than the second condenser if both condensers are employed with the same coil of inductance. And in addition to this, the upper wavelength limit of the circuit will be four times as high when using the .002 mfd. condenser as compared to a circuit with the same value of inductance, but using the condenser which has a maximum capacity of .0005 mfd.

Therefore when about to purchase a variable condenser for the radio receiver, decide about how much you are able to spend for your whole receiver and allot to condensers their proportionate part of the entire amount so that all of the apparatus will be of at least approximately the same grade and so that nothing will seem out of place either mechanically or electrically. Then select your condensers with a regard to their electrical dimensions, about which more will be said in the second part of this article.

Selecting Loud Speakers

(*Continued from page 33*)

selections will sound noisy and will have a drumming quality.

2. The loud speaker fails to reproduce low pitched notes, but does respond to high pitched notes. Speech will will be fairly intelligible on such loud speakers, but the piano will sound thin and much like a harp or guitar. Bass voices will be weak or else sound like thin baritones. The effect in the rendition of orchestral selections will be feeble and squeaky, and without "body" and roundness. The accompaniment of the 'cellos and violins, and other deep-voiced instruments will be lost. The general effect will be that of a cheap and poorly designed portable phonograph with a small horn.

3. The loud speaker may reproduce only notes in the middle register, dropping out high and low pitched notes. This is unfortunately a fairly common fault. While speech is moderately intelligible on some examples of this class of instruments, music is very unmercifully treated, and the faults found are a combination of those mentioned in 1 and 2 above.

4. Loud speakers should not rattle on the loudest notes which are produced; but the user should be cautious in drawing conclusions since he may be overloading his radiotrons by excessively loud signals, combined with low plate voltage and incorrect grid bias. Unless the listener is sure the radiotrons are not themselves being "saturated" or overloaded, he should not blame the loud speaker for rattling noises. The best way of checking up on this point is by trying a known reliable loud speaker on the set in place of the suspected one.

5. Loud speakers occasionally are insensitive; that is, they fail to respond to weak signals at all, and do not give a good response to reasonably loud signals. The only test is by comparison with standard makes. The objection to insensitive loud speakers is the necessity for overloading the radiotrons to get a loud signal.

6. Some loud speakers, while otherwise fairly satisfactory, reproduce combinations of instruments — voice and piano, or violin and piano—less satisfactorily than solo efforts. This fault requires for proof of its existence a careful listening test on a suitable selection from a broadcasting station of repeatedly proven high quality.

It is not implied that the above rough listening tests are an effective substitute for a precision laboratory test of a loud speaker under properly controlled conditions. Conclusions badly in error may sometimes be drawn from a single unsuitable listening test with the loud speaker fed from an unreliable broadcasting station or from an unsuitable receiving set, yet the preceding suggestions do give a general idea of the defects of some loud speakers.

It may be justly said that radio broadcast reception stands or falls in large part on the merits or defects of the loud speaker, since it is this device which finally produces the desired entertainment. It is therefore regrettable that so many inferior articles of this type have been placed on the market by self-styled "experts" who were actually lamentably ignorant of the requirements of the problem. The influence of such loud speakers on the reputation of radio reception has been undesirable. Fortunately quantitative tests and exact design methods are now available, and suitable loud speakers can be obtained. Continued improvement in these devices may also be confidently expected until it will become nearly impossible to distinguish between loud speaker output and the original studio rendition of a musical selection.

Radio Frequency Circuits

The Practical Use of Honeycomb Coils and Regeneration in Radio Frequency Amplification

By Henry Baron

THE writer has tried out quite a number of radio frequency amplifier circuits and has thought that possibly some of the results obtained from actual practice might be of value to the radio man who builds his own apparatus. There are a number of peculiar things that happen in radio-frequency sets which are not met with in the ordinary detector and two-step or simple detector outfits.

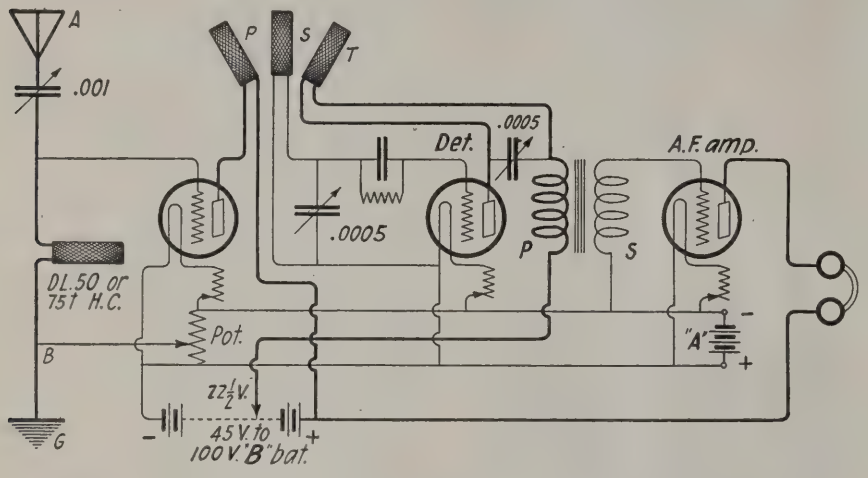


Figure 1—Hook-up of one step of radio frequency, detector and one step of audio frequency amplification

Radio-Frequency With Honeycomb Coils

Figure 1 shows a circuit which several friends of mine have been using for a year or more and which I have also tried out. This circuit provides one stage of inductively coupled radio-frequency amplification, and one stage of audio-frequency amplification. A second stage of audio-frequency can be added to operate the loudspeaker when desired. Referring to the diagram, it will be seen that a loop shunted by a .001 mfd. variable condenser, preferably of the vernier type, may be shunted across the grid and filament circuit at A and B, or else an outdoor antenna used with a .001 mfd. variable condenser used in series with a 50 or 75-turn honeycomb coil, as shown. The coupling and regeneration are taken care of by three honeycomb coils used in a regular three-coil mount provided with gears, or simply with knobs, utilizing a 50-turn honeycomb coil for the primary, a 50-turn coil for the secondary, and a 35 or 50-turn coil for the tickler.

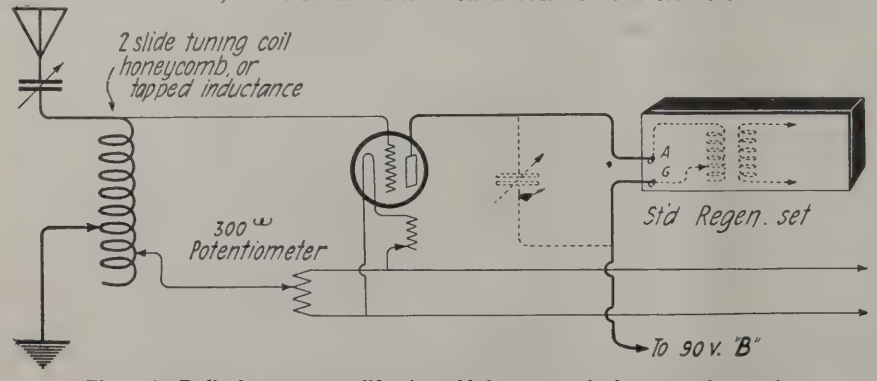


Figure 3—Radio frequency amplification added to a standard regenerative receiver

There are several different arrangements of this circuit which have been published and tried out; for instance a variable condenser of the 23 or 43-plate type may be used across the primary coil, but this set works very well with a .0005 mfd. variable condenser connected across the secondary, and a similar variable condenser connected across the tickler. The latter should of course be of the vernier type, as this control is very critical. If but one stage of audio-frequency is used, as indicated at figure 1, then the audio frequency transformer utilized should have a fairly high ratio, say 5 or 6 to 1, and it will be found the most satisfactory to purchase a good sized transformer, and not a small one for this stage, or in fact for any successive stages. The large sized transformers, several of which are now available on the market, have a lower resistance for one thing than the smaller transformers, and owing to the greater quantity of large sized copper wire used in winding the primary and secondary coils, together with the lower flux density in the iron core, the operating efficiency is improved all around,

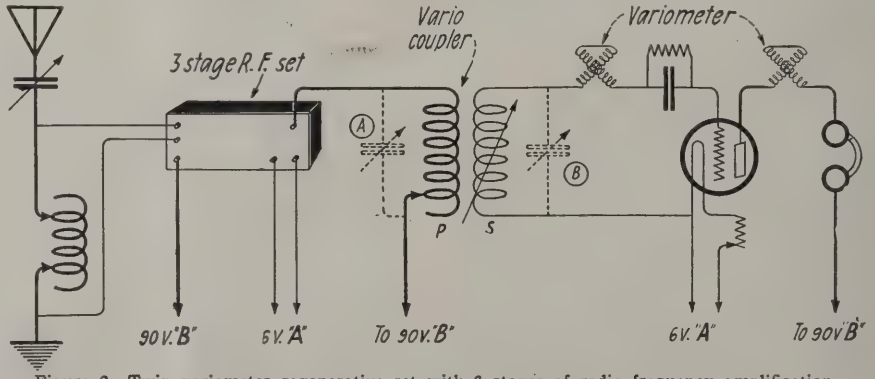


Figure 2—Twin variometer regenerative set with 3 stages of radio frequency amplification

and these large transformers selling for $6.00 or $7.00 are certainly a fine investment and one that you will never regret. There is a great deal of talk nowadays about using decreasing ratios between the windings and the transformers for the different ratios, that is, a higher ratio in the first stage and a lower ratio in the second stage, but some of the best commercial sets being turned out today utilize two of the large audio frequency transformers just mentioned, with identical ratios, and they certainly do deliver the goods. The writer at present is using two Schermatron transformers of the same ratio, and they leave nothing to be desired. A potentiometer of 200 to 300

(*Continued on page* 84)

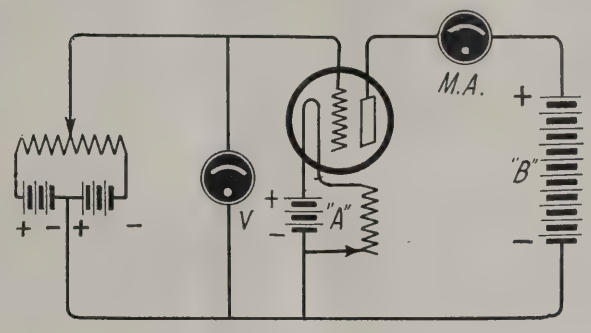
RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Vacuum Tubes

AS the main purpose of this course is to summarize and to some extent supplement the textbook study and experimental work of the student, this and succeeding chapters on vacuum tube operation should be read only after the subject has been studied in the textbooks recommended at the beginning of the course. In fact it would be well for the student to gather together and carefully study all available data on tubes. If Professor Morecroft's *Principles of Radio Communication* can be secured read the section between pages 364 and 577.



From our text books we should have found that a vacuum tube—or better termed—a triode—as used in radio communication has three elements: a filament, a metallic plate surrounding the filament and a grid or wire mesh interposed between the filament and plate.

When the filament is heated—generally by an electric current—it emits negative electrons which may be attracted to the plate if the latter is charged positively with respect to the filament. The quantity of electrons emitted from the filament depends mainly upon the temperature and structure of the filament; secondarily upon the charge surrounding the filament.

The quantity of electrons reaching the plate depends upon the difference in voltage between the plate and filament and upon the space charge, or charge in the space between these electrodes. If the space charge is negative—with respect to the filament—the electrons from the filament will be repelled and most of them will fall back upon the filament. If the space charge is positive, the flow of electrons from the filament to the plate will be increased.

Control of the space charge is the purpose of the grid; as its voltage varies, the space charge varies in exact accordance and the electronic flow and plate current change correspondingly. If the grid voltage varies at a radio frequency the plate current will vary at a radio frequency; if the grid voltage varies at an audio frequency the plate current will vary at an audio frequency.

The relationship between the grid voltage and the plate current is the most important factor in vacuum tube operation.

This relationship is generally graphically represented with a grid-plate characteristic curve. The measurements from which the curves may be drawn may be secured experimentally for any tube with a testing circuit similar to the diagram.

Here a vacuum tube is arranged with suitable A and B (filament and plate) batteries and a special C (grid) battery that may be adjusted to maintain the grid at any desired negative or positive voltage with respect to the negative terminal of the filament. A grid circuit voltmeter to show the voltage difference between the grid and the negative terminal of the filament, and a plate current ammeter to register the current in the plate circuit, are necessary to obtain the desired measurements.

In using such a testing circuit, the filament and plate battery voltages are kept constant for any one curve. The grid voltage is made negative to a value where the plate current is zero and then, advancing the grid voltage in steps toward zero and positive values, readings are noted of the plate current values corresponding to each step in grid voltage. The upper limit of grid voltage is usually restricted to that value where further increase does not increase the plate current.

Grid voltages and corresponding plate current values for an assumed case of a small tube are given here:

Grid Voltage	Plate Current	Grid Voltage	Plate Current
—6	0.00	3	1.50
—5	0.01	4	1.65
—4	0.10	5	1.90
—3	0.20	6	2.10
—2	0.35	7	2.20
—1	0.55	8	2.28
0	0.75	9	2.32
1	1.00	10	2.35
2	1.25	11	2.37

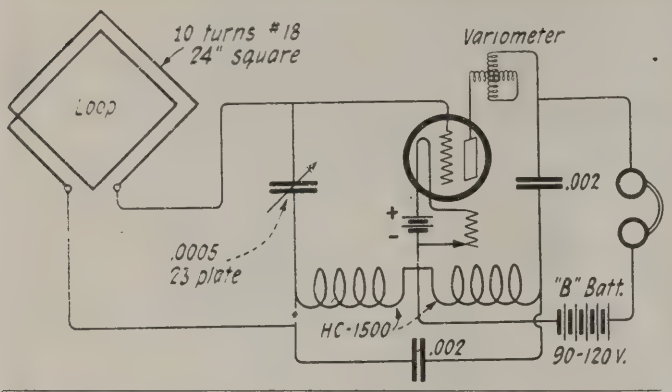
The student may make up a curve from these figures. Secure a piece of cross-section or graph paper and along the left hand vertical line mark off units of plate current; say one square to represent one-tenth of a milliampere. Then along the horizontal bottom line mark units of grid voltage, say one volt to a square, starting at the left with —6 and going as many squares to the right as necessary to number up to positive 11. Then on the minus 5 line make a dot up 1/10 of the first .1 milliampere square to correspond to .01 milliampere; the value of plate current when the grid is —5. Do the same with all the other grid voltage-plate current combinations and after all the dots have been plotted, connect them together with a smooth curve. This should look similar to those shown in textbooks if drawn corrrectly.

Now that we have the grid voltage-plate current curve, what are we going to do with it? For one thing we can see how the vacuum tube operates as an amplifier.

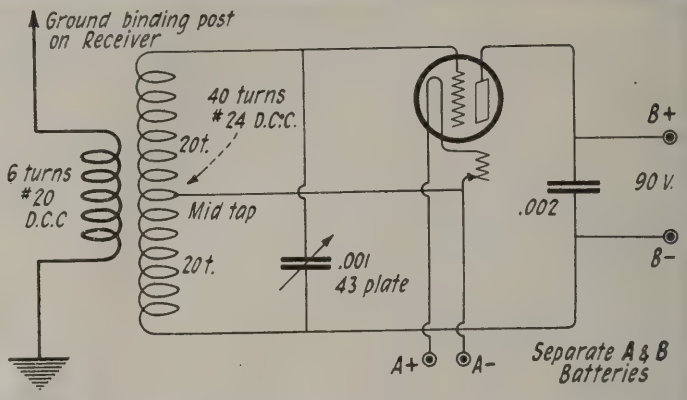
(To be continued.)

THIS Course of Instruction in Radio Engineering commenced with the February issue of The Wireless Age. In that issue the author described a simple home laboratory layout of apparatus which students could make up at small cost. This apparatus was designed to enable the student to experiment for himself along the lines suggested by the author, so that by carefully following the course students may really learn Radio. In subsequent issues were presented first some elementary instruction about circuits, then two chapters on inter-tube coupling, including the study of impedance, grid-leaks, resistance coupling and transformers, which brings the student next to a study of the operation of vacuum tubes, the subject of the present chapter. The author recommended the use of supplementary text books, particularly one by E. E. Bucher entitled "Wireless Experimenter's Manual."

Selected Radio Hook-Ups



FROM the number of requests which we receive daily we gather that the one tube super is still popular as ever. Diagram of this set is shown in figure 1. The loop is tuned with a 23 plate variable condenser preferably with some means of vernier adjustment. A Hammarlund would be particularly fitting here. The two honeycomb coils 1500 turns each are a necessary part of the circuit.



IN figure 2 is shown an external oscillator which can be used with excellent results with most any radio frequency receiver. This oscillator consists of 40 turns of No. 24 double cotton covered wire wound on a three inch in diameter cardboard tube. Three eighths of an inch from this coil another winding is placed consisting of six turns of No. 20 double cotton covered wire.

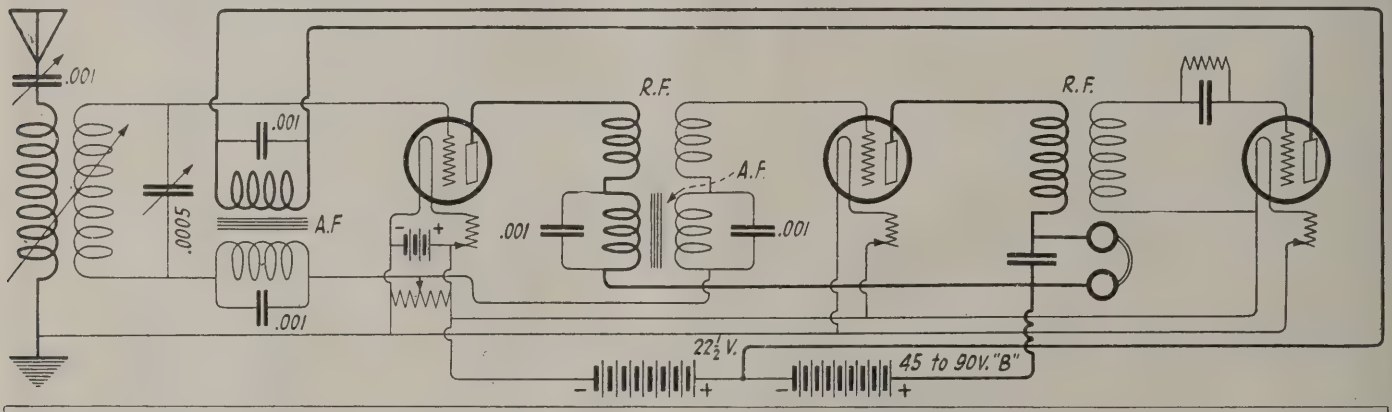
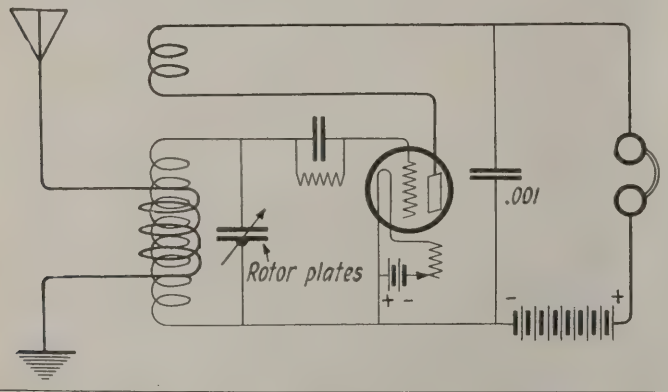
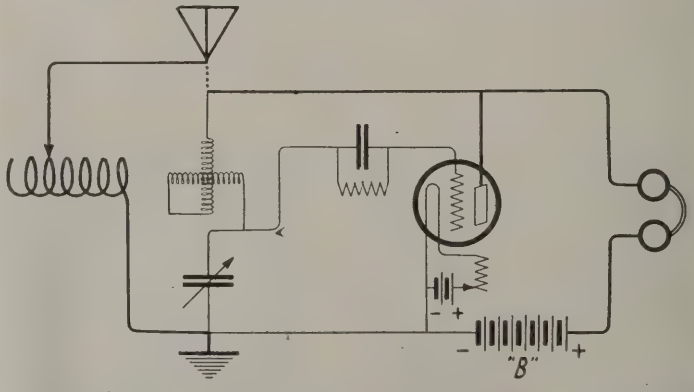


FIGURE 3 shows the ever popular Grimes Inverse Duplex Receiver. The diagram is clear and explains itself. This is a rather difficult set to get into operation and satisfactory working conditions but is nevertheless an interesting one to experiment with. The set consists of three tubes two of which perform as radio and audio frequency amplifiers. It differs from ordinary reflex in that the first stage audio is reflexed back in the second stage of radio and the second stage of audio is reflexed back into the first stage of radio. This arrangement provides for better balance in the work of each tube and prevents overworking any one particular tube. The main tuning unit consists of a variocoupler whose secondary is tuned by a 23 plate variable condenser. A 43 plate condenser is inserted in the antenna lead.

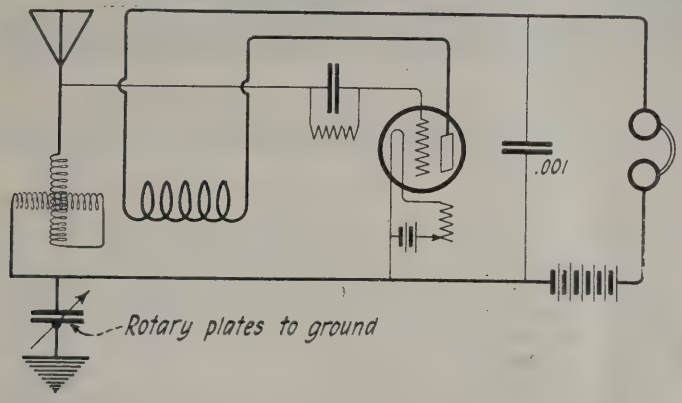


WE still have with us too many of the old standby. We have shown how the single circuit tuner may be changed to a three circuit arrangement which will greatly enhance its selectivity. In figure 4-A the antenna and ground are disconnected from their original positions and connected to the two ends of six turns of windings placed directly over the original windings on the stationary coil.

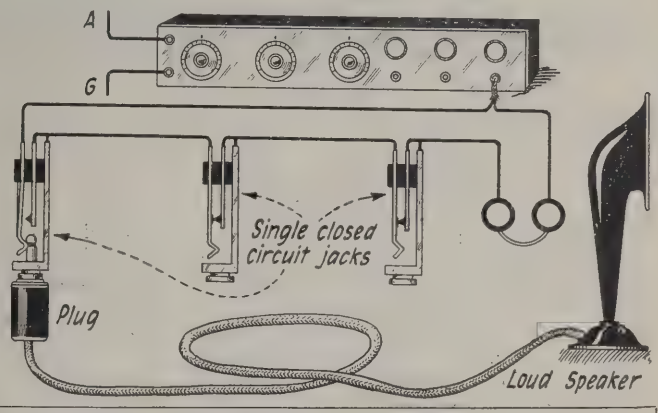


IN figure 4-B the Colpitts' oscillator circuit, one of the worst tuners in creation, is changed to an inductively coupled set. The antenna is tuned by means of a 35 turn coil wound on to a three inch tube and tapped every 5 turns. In winding this coil use large wire, preferably No. 20. This makes the tuner an inductively coupled circuit with a tuned primary.

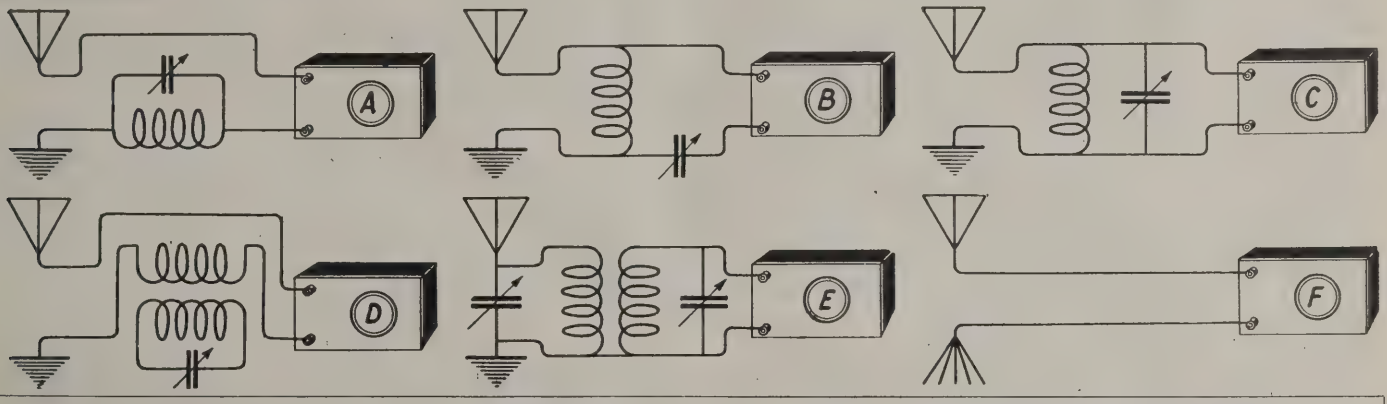
For the Home Builder



A MAN came into our office and told us that he had heard Frisco on the set hooked up according to the diagram in figure 5. We were skeptical as usual so we were invited out to hear it for ourselves. We didn't hear it but we heard nearly every other station this side of the Rocky Mountains. It combines tickler and tuned plate feed back in obtaining regeneration.

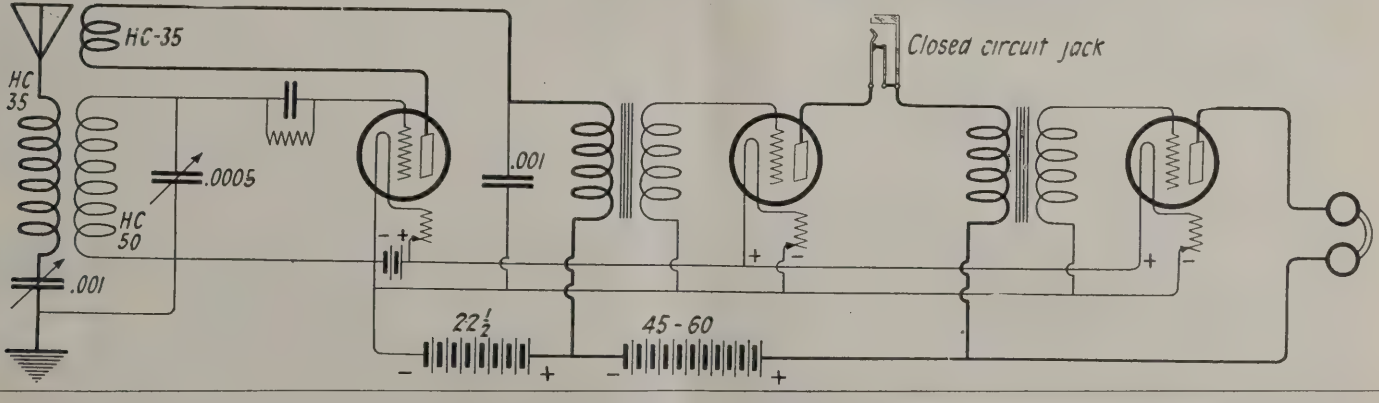


IN figure 6 we have shown an arrangement that will provide loud speaker connections for your receiver in each room of the house. The phone jacks are placed in the mounting similarly to the wall plugs carrying the house lighting in the modern house and a single closed circuit for jacks. By using this type jack any number of loud speakers can be connected into the phone circuit.



IN figure 7 we have shown six ways of eliminating interference and sharpening your tuning. The first five are developments of the wave trap and the sixth is the use of a counterpoise instead of a ground. In each of the trap circuits the coil is a 50-turn honeycomb coil and the tuning condenser a 23 plate .0005 mfd. The counterpoise system shown in figure F is generally the last resort when a receiver is located very close to one or two powerful broadcasting stations. The counterpoise consists of one to four wires the same length as the aerial and insulated the same, placed between the aerial and ground, from thirty to forty feet below the antenna.

A connection is then made from the counterpoise to the ground binding post on your set.



WE STILL have requests for the popular old standby, the three honeycomb coil detector and two step receiver. This is shown in figure 8. You will note that there is no jack provided for plugging in on the detector tube. The practice of omitting this jack is becoming more pronounced as people realize that when a signal is tuned in with the phones in the detector jack it very often is not there when the phones are plugged in the first or second step due to the difference in impedance which the phones offer with respect to the primary winding of the first audio frequency transformer.

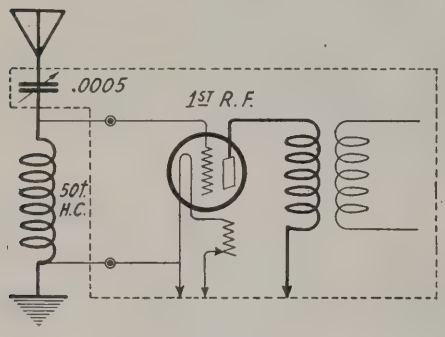
We ask our readers in requesting hook-ups and circuit diagrams for a particular type of receiver to look through our back issues before writing us.

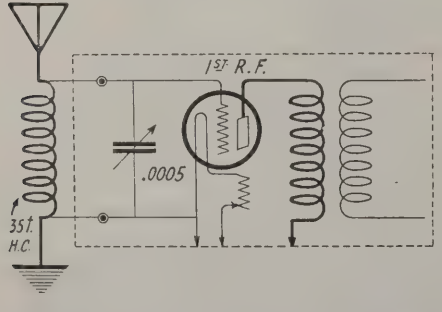
CONDUCTED BY R. A. BRADLEY

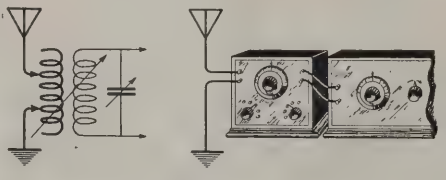
Due to the great volume of correspondence which this department entails we are forced to remind our readers on the following points: Be sure to enclose a self-addressed stamped envelope with your letter. Make your questions clear and concise. If you wish information on your set please enclose a rough sketch or hook-up if possible. Do not ask us to make comparisons between different makes of apparatus or sets.

The Wireless Age Reflex Loop Receiver Described in the April Issue

Judging from the requests we have received from our readers, it is evident that many persons who have built the reflex loop receiver which was described in our April issue, wish to make this sensitive receiver adaptable to use with an outside antenna. When such a set as this is used with an outside antenna the results obtained generally resemble a boarding-house hash of all stations at once regardless of the frantic manipulation of the wavelength dial. This is due to some extent to the sensitivity of the receiver and also to the resistance of the tuning circuit which in this case happens to be the conventional single circuit shown in figure 1, and consists of a fifty turn honeycomb coil or variometer tuned by means of a series or shunt condenser. In figure 1, the antenna circuit is really the only tuned circuit in the whole receiver, while the grid circuit of the first radio frequency tube which should be sharply tuned is in reality fixed at the frequency of the coil. In figure 2, the antenna circuit and the grid circuit are both tuned simultaneously, but can never be brought into absolute resonance. The wavelength to which the grid circuit is tuned is determined by the capacity of the condenser and the inductance of the coil, while the frequency of the antenna circuit is dependent on these things and also the added inductance and capacity in the antenna and ground systems. So it will be readily seen that to have maximum selectivity it is necessary to tune these two circuits independently and bring them into resonance in this fashion. In figure 3 we have an ordinary 180 degree variocoupler mounted on a 7"x7" hard rubber panel with taps and tap switches, the whole placed in a small cabinet and placed near the left end of the receiver. The four terminals of this instrument are brought out to four binding posts conveniently arranged on the front panel. Connections are made from the two binding posts on the receiver, to which previously were connected the two leads from the loop antenna, now to the binding posts on the right hand end of the variocoupler panel. From these two posts two leads run to the secondary of the coupler. The wires from the two tap switches run to the two binding posts on the left of the coupler panel. To these are connected the aerial and ground leads. In operating this new device the coupling between the primary and secondary coils is set at maximum, that is, with their respective windings parallel







and a signal tuned in with the variable condenser on the receiver. The tap switches are now adjusted for maximum intensity. Now using one hand to vary the setting of the condenser and the other to vary the coupling dial gradually reduce the coupling between the coils and at the same time readjust the setting of the condenser dial if necessary to make up for any change in wavelength brought about by the change in coupling. It will generally be found that as the coupling is reduced it is necessary to increase the condenser setting.

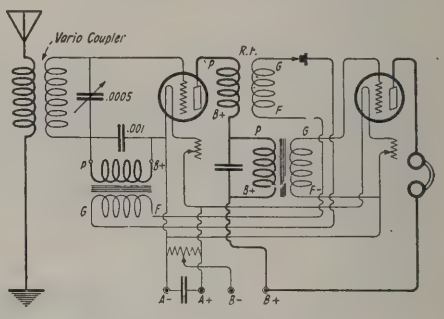
Generator Hum

C. W. Engelder of Norfolk, Va., is troubled with a constant hum in the receivers whenever his set is turned on. He says: "Evidently this hum cannot be tuned out as I have tried in vain to do so."

This trouble is often due to the receiving set being placed in close proximity with the house light wiring. If your house happens to be wired with A.C. it is more noticeable. The placing of a stand lamp or desk lamp on the same table as the set is placed on will also produce this hum. To eliminate it, you must either change the position of the set or the wiring itself keeping every part of the set, even the antenna and ground wires, as far away as possible from the light wires.

Two-Tube Selective Reflex Set

Mr. Anthony Gaffney of Rockville Center, L. I., wishes a hook-up for a selective reflex set using two tubes. "One tube to be used for straight audio frequency amplification." The circuit for this is shown below.

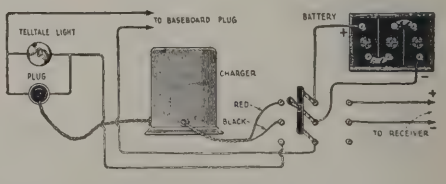


Needs a Grid Condenser

L. J. Meyers of Haverford, Ill., encloses the circuit diagram for his receiver together with a list of the parts which he uses. The set is home made and so far has refused to give forth any sound except a piercing howl despite the adjustment of the dials. Mr. Meyers, if you have given us the exact list of apparatus, you have neglected to include a very necessary grid condenser, .00025 mfd. capacity which should be connected across the grid leak terminals.

Switching Arrangement for Charging

"It is necessary for me to be away from home perhaps for a month or more at a time and my storage battery in that time frequently goes dead. I should like to have an arrangement whereby throwing a switch the other members of the family could put the battery on charge or use it on the set, without connecting and disconnecting a lot of wires, etc.," writes S. G. Fisk of White Plains, N Y.



This arrangement was shown in D. G. Ward's article on storage batteries in the April issue. However we are reprinting it here as its simplicity and handiness will appeal to many readers in a similar circumstance.

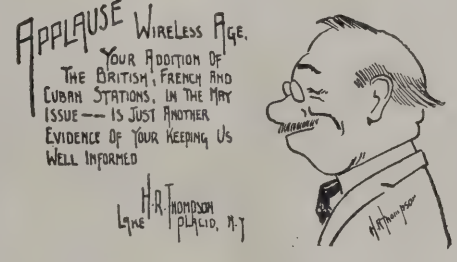
(*Continued on page 74*)

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Newhouse Hotel.....Salt Lake City, Utah.	360
KDYM	Savoy Theater.....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYW	Smith Hughes & Co.....Phoenix, Ariz.	360
KDYX	Star Bulletin.....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co. .....Seattle, Wash.	270
KDZF	Automobile Club of So. Calif., Los Angeles, Calif.	278
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing.....Denver, Colo.	360
KDZR	Bellingham Publishing Co., Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co...Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp. .....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co...Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho.	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Leese Bros.....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and The Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral.....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	238
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)..Billings, Mont.	360
KFCM	Richmond Radio Shop.....Richmond, Calif.	360
KFCP	Ralph W. Flygare.....Ogden, Utah.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	360
KFDJ	Oregon Agricultural College.....Corvallis, Ore.	360
KFDO	H. Everett Cutting.....Boseman, Mont.	248
KFDR	Bullock's Hdw. & Sporting Goods, York, Nebr.	360
KFDV	Gilbrecht & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEJ	Guy Greason .....Tacoma, Wash.	360
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary.....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	American Society of Mech. Engs., St. Louis, Mo.	360
KFFB	Jenkins Furniture Co. .....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheffel Motor Co....Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co., Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford Univ., Calif.	360
KFGL	Snell & Irby.....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary College, Berrien Springs, Mich.	268
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theatre.....Hood River, Ore.	280
KFHD	Utz Radio & Electric Co.....St. Joseph, Mo.	226
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co. .....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seattle, Wash.	283
KFHS	Clifford J. Dow.....Lihue, Hawaii	275
KFHX	Robert W. Nelson.....Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)....Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage.....Iola, Kans.	246
KFIF	Benson Polytechnic Institute.....Portland, Ore.	360
KFIL	Windisch Elec. Farm Equip Co., Louisburg, Kans.	234
KFIO	North Central High School....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fon-du-lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash	270
KFJF	National Radio Mfg. Co..Oklahoma City, Okla.	252
KFJI	Liberty Theatre .....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co....Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.....Ottumwa, Iowa.	242
KFJM	University of North Dakota, Grand Forks, N. D.	280
KFJQ	Electric Construction Co., Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJW	Le Grand Radio Co.....Towanda, Kans.	226
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112 Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers College..Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	224
KFKV	F. F. Gray .....Butte, Mont.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co...Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa.	261
KFMS	Freimuth Department Store....Duluth, Minn.	275
KFMT	George W. Young.....Minneapolis, Minn.	231


APPLAUSE WIRELESS AGE.
YOUR ADDITION OF THE BRITISH, FRENCH AND CUBAN STATIONS, IN THE MAY ISSUE — IS JUST ANOTHER EVIDENCE OF YOUR KEEPING US WELL INFORMED
H.R. THOMPSON
LAKE PLACID, N.Y.

KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Satern.....Houghton, Mich.	266
KFMX	Carleton College.....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club....Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr. .....Corsicana, Tex.	234
KFNF	Henry Field Seed Co.....Shenandoah Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	238
KFNJ	Warrensburg Electric Shop...Warrensburg, Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co. .....Helena, Mont.	261
KFNZ	Royal Radio Co. .....Burlingam, Calif.	231
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFOB	Glenwood Technical Assn., Minneapolis, Minn.	224
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow .....Portland, Ore.	283
KFOJ	Moberly High School Radio Club, Moberly, Mo.	246
KFOL	Leslie M. Schafbuch .....Marengo, Iowa	234
KFON	Echophone Radio Shop.....Long Beach, Calif.	234
KFOP	Willson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock Watson Radio Service..Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times-Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	273
KJR	Northwest Radio Service Co.....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	Sap Joaquin Light & Power Corp., Fresno, Cal.	248
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Grays Harbor Radio Co.....Aberdeen, Wash.	283
KNV	Radio Supply Co.....Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co., Pittsburgh, Pa.	273
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch.....St. Louis, Mo.	546
KSS	Prest & Dean Radio Co., and Radio Research Society of Long Beach, Long Beach, Calif.	360
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co.....San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co., Los Angeles, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co...Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZN	Cape & Johnson.....Salt Lake City, Utah	268
KZV	Wenatchee Bat. & Motor Co., Wenatchee, Wash.	360
WAAB	Valdemar Jensen.....New Orleans, La.	268
WAAC	Tulane University.....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	John B. Lawrence.....Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.....Bangor, Me.	246
WABL	Connecticut Agricultural College...Storrs, Conn.	283
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WABP	Robert F. Weinig.....Dover, Ohio	286
WABQ	Haverford College Radio Club..Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. De Witt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaidi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church..New Orleans, La.	263
WBAA	Purdue University.....West Lafayette, Ind.	360
WBAD	Sterling Electric Co.....Minneapolis, Minn.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBE	Alfred R. Marcy.....Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya.....Mattapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBI	Indianapolis Radio Club.....Indianapolis, Ind.	234
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co..Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook.....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Associations....Rossville, N. Y.	244
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	224
WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222
WBBY	Washington Light Infantry....Charleston, S. C.	268
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227

WBL	T. & H. Radio Co.....Anthony, Kans.	261
WSB	D. W. May (Inc.).....Newark, N. J.	360
WBT	Southern Radio Corporation...Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel.....Houston, Tex.	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp. of Texas, San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.	280
WCAT	South Dakota State School of Mines, Rapid City, S. Dak.	240
WCAU	Durham & Co.....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont.....Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.....Milwaukee, Wis.	261
WCAZ	Carthage College.....Carthage, Ill.	246
WCBA	Charles W. Helmbach.....Allentown, Pa.	280
WCBC	University of Michigan.....Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva.....Zion, Ill.	345
WCBE	Uhalt Radio Co.....New Orleans, La.	263
WCBG	Howard S. Williams.....Pascagoula, Miss.	236
WCBH	University of Mississippi.....Oxford, Miss.	242
WCK	Stix-Baer & Fuller Dry Goods Co., St. Louis, Mo.	360
WCM	University of Texas.....Austin, Tex.	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star.....Kansas City, Mo.	411
WDAG	J. Laurance Martin.....Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South), El Paso, Tex.	268
WDAK	The Courant.....Hartford, Conn.	261
WDAO	Automotive Electric Co.....Dallas, Tex.	360
WDAP	Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers.....Philadelphia, Pa.	395
WDAS	Samuel A. Waite.....Worcester, Mass.	360
WDAU	Slocum & Kilburn.....New Bedford, Mass.	360
WDAY	Radio Equipment Corporation, Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.....Lancaster, Pa.	258
WDM	Church of the Covenant.....Washington, D. C.	234
WDZ	James L. Bush.....Tuscola, Ill.	278
WEAA	Frank D. Fallain.....Flint, Mich.	250
WEAF	American Tel. & Tel. Co.....New York, N. Y.	492
WEAH	Wichita Board of Trade.....Wichita, Kans.	280
WEAI	Cornell University.....Ithaca, N. Y.	286
WEAJ	University of South Dakota..Vermilion, S. Dak.	283
WEAM	Borough of North Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co.....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co.....Mobile, Ala.	360
WEAR	Baltimore American and News Publishing Co., Baltimore, Md.	360
WEAU	Davidson Bros. Co.....Sioux City, Iowa	360
WEAY	Iris Theater .....Houston, Tex.	360
WEB	Benwood Co.....St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFAA	Dallas News and Dallas Journal..Dallas, Tex.	476
WFAB	Carl F. Woese.....Syracuse, N. Y.	234
WFAM	Times Publishing Co.....St. Cloud, Minn.	273
WVX	H. C. Spratley Radio Co...Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrum't Co., Asheville, N. C.	360
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College.....Cameron, Mo.	360
WFAT	New Columbus College.....Sioux Falls, S. Dak.	258
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd.....Pensacola, Fla.	360
WGAQ	Glenwood Radio Corporation....Shreveport, La.	252
WGAW	Ernest C. Albright.....Altoona, Pa.	261
WGAZ	South Bend Tribune.....South Bend, Ind.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	242
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wis.	360
WHAA	State University of Iowa.....Iowa City, Iowa	484
WHAB	Clark W. Thompson.....Galveston, Tex.	360
WHAD	Marquette University.....Milwaukee, Wis.	280
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	Hafer Supply Co.....Joplin, Mo.	283
WHAK	Roberts Hardware Co.....Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music), Rochester, N. Y.	283
WHAP	Otta and Kuhns.....Decatur, Ill.	360
WHAR	Seaside House .....Atlantic City, N. J.	231
WHAS	Courier-Journal and Louisville Times, Louisville, Ky.	400
WHAV	Wilmington Elecl. Spec. Co., Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHK	Radiovox Co.....Cleveland, Ohio	283
WHN	George Schubel.....New York, N. Y.	360
WIAB	Joslyn Automobile Co.....Rockford, Ill.	252
WIAC	Galveston Tribune.....Galveston, Tex.	360
WIAD	Howard R. Miller.....Philadelphia, Pa.	254
WIAF	Gustav A. DeCortin.....New Orleans, La.	234
WIAI	Heer Stores Co.....Springfield, Mo.	252
WIAJ	Fox River Valley Radio Sup. Co., Neenah, Wis.	224
WIAK	Journal-Stockman Co.....Omaha, Nebr.	278
WIAO	School of Eng'g of Milwaukee, Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Home Electric Co.....Burlington, Iowa	360
WIAU	American Trust Savings Bank, Le Mars, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co., Washington, D. C.	360
WIP	Gimbel Bros.....Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories, Waco, Tex.	360
WJAF	Muncie Press and Smith Elec. Co., Muncie, Ind.	360
WJAG	Norfolk Dairy News.....Norfolk, Nebr.	283
WJAK	Clifford L. White.....Greentown, Ind.	254
WJAM	D. M. Perham.....Cedar Rapids, Iowa	268
WJAN	Peoria Star.....Peoria, Ill.	280
WJAQ	Capper Publications.....Topeka, Kans.	360
WJAR	The Outlet Co.....Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250
WJAT	Kelley-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co.....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory.....Chicago, Ill.	448
WJD	Denison University.....Granville, Ohio	229
WJX	Deforest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corporation of America..New York, N. Y.	405
WJZ	Radio Corporation of America, New York, N. Y.	455
WKAA	H. F. Paar.....Cedar Rapids, Iowa	268
WKAD	Charles Looff (Crescent Park), E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co...Wichita Falls, Tex.	360
WKAN	United Battery Service Co....Montgomery, Ala.	226
WKAP	Dutee W. Flint.....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College, East Lansing, Mich.	280
WKAV	Laconia Radio Club.....Laconia, N. H.	254
WKY	WKY Radio Shop.....Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation, Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.....Tulsa, Okla.	360
WLAP	W. V. Jordon.....Louisville, Ky.	360
WLAQ	Arthur E. Schilling.....Kalamazoo, Mich.	283
WLAV	Electric Shop.....Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y., New York N. Y.	360
WLAX	Putnam Electric Co.....Greencastle, Ind.	231
WLB	University of Minnesota....Minneapolis, Minn.	360
WLW	Crosley Mfg. Co.....Cincinnati, Ohio	309
WMAB	Radio Supply Co.....Oklahoma, Okla.	360
WMAC	Clive B. Meredith.....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp....Dartmouth, Mass.	360
WMAH	General Supply Co.....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.....Kansas City, Mo.	275
WMAK	Norton Laboratories.....Lockport, N. Y.	360
WMAL	Trenton Hardware Co.....Trenton, N. J.	256
WMAN	First Baptist Church.....Columbus, Ohio	286
WMAP	Utility Battery Service.....Easton, Pa.	246
WMAQ	Chicago Daily News.....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAW	Wahpeton Electric Co.....Wahpeton, N. Dak.	254
WMAY	Kingshighway Presby. Church, St. Louis, Mo.	280
WMAZ	Mercer University .....Macon, Ga.	268
WMC	Commercial Appeal.....Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co..Washington, D. C.	261
WNAC	Shepard Stores.....Boston, Mass.	278
WNAD	University of Oklahoma.....Norman, Okla.	360
WNAL	R. J. Rockwell.....Omaha, Nebr.	266
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.	286
WNAP	Wittenberg College.....Springfield, Ohio	275
WNAQ	Charleston Radio Elec. Co....Charleston, S. C.	360
WNAR	C. C. Rhodes .....Butler, Mo.	231
WNAS	Texas Radio Corp. and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Brothers Co.....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Telg. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzman....Box 167, Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.Yankton, S. Dak.	244
WNJ	Shotton Radio Mfg. Co.....Albany, N. Y.	360
WOAC	Page Organ Co. (H. P. Maus).....Lima, Ohio	266
WOAD	Friady Battery & Electric Corp., Sigourney, Iowa.	360
WOAE	Midland College.....Fremont, Neb.	360
WOAF	Tyler Commercial College.....Tyler, Tex.	360
WOAG	Appollo Theatre.....Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation..Charleston, S. C.	360
WOAI	Southern Equipment Co....San Antonio, Tex.	385
WOAN	James D. Vaughn.....Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.....Mishawaka, Ind.	360
WOAP	Kalmazoo College.....Kalamazoo, Mich.	283
WOAR	Henry P. Lundskow.....Kenosha, Wis.	229
WOAT	Boyd M. Hamp.....Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 112th Inf..Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Neb.	526
WOAX	Franklyn J. Wolff.....Trenton, N. J.	240
WOC	Palmer School of Chiropractic..Davenport, Iowa	484
WOI	Iowa State College.....Ames, Iowa	360
WOK	Pine Bluff Co.....Pine Bluff, Ark.	360
WOO	John Wanamaker.....Philadelphia, Pa.	509
WOQ	Western Radio Co.....Kansas City, Mo.	360
WOR	L. Bamberger & Co.....Newark, N. J.	405
WOS	Missouri State Market'g Bu., Jefferson City, Mo.	441
WPAB	Pennsylvania State College...State College, Pa.	283
WPAC	Donaldson Radio Co.....Okmulgee, Okla.	330
WPAJ	Doolittle Radio Corp.....New Haven, Conn.	268
WPAK	North Dakota Agricultural College, Agricultural College, N. Dakota	360
WPAL	Avery & Loeb Electric Co.....Columbus, Ohio	286
WPAM	Auerbach & Guettel.....Topeka, Kans.	360
WPAP	Theodore D. Phillips.....Winchester, Ky.	360
WPAQ	General Sales & Engineering Co., Frostburg, Md.	360
WPAT	St. Patrick's Cathedral.....El Paso, Tex.	360
WPAU	Concordia College .....Moorhead, Minn.	360
WPAZ	John R. Koch.....Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.....Parkesburg, Pa.	360
WQAC	E. B. Gish.....Amarillo, Texas	234
WQAD	Whitall Electric Co.....Waterbury, Conn.	242
WQAE	Moore Radio News Station....Springfield, Vt.	275
WQAF	Sandusky Register.....Sandusky, Ohio	240
WQAL	Coles County Tele. & Teleg. Co...Mattoon, Ill.	258
WQAM	Electrical Equipment Co.....Miami, Fla.	283
WQAN	Scranton Times.....Scranton, Pa.	280
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	W. Texas Radio Co. (Abilene Dairy Reporter) Abilene, Texas	360
WQAS	Prince-Walter Co.....Lowell, Mass.	266
WQAW	Catholic University.....Washington, D. C.	236
WQAX	Radio Equipment Co.....Peoria, Ill.	360
WRAA	Rice Institute.....Houston, Texas	360
WRAF	The Radio Club.....Laporte, Ind.	224
WRAH	Stanley N. Read.....Providence, R. I.	231
WRAL	Northern States Power Co., St. Croix Falls, Wis.	248
WRAM	Lombard College.....Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.....Waterloo, Iowa	236
WRAO	St. Louis Radio Service Co.....St. Louis Mo.	360
WRAV	Antioch College.....Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop.....Reading, Pa.	238
WRAX	Flexon's Garage.....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation.....Scranton, Pa.	280
WRAZ	Radio Shop of Newark.....Newark, N. J.	233
WRC	Radio Corporation of America, Washington, D. C.	469
WRK	Doron Bros. Electrical Co.....Hamilton, Ohio	360
WRL	Union College.....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas, Police and Fire Signal Dept. Dallas, Texas	360
WRW	Tarrytown Radio Res'rch Lab., Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College, Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural Col., Clemson College, S. C.	360
WSAD	J. A. Foster Co.....Providence, R. I.	261
WSAG	Loren V. Davis and George Prestman, Sr., St. Petersburg, Fla.	244
WSAI	United States Playing Card Co., Cincinnati, O.	309
WSAJ	Grove City College.....Grove City, Pa.	360
WSAN	Allentown Radio Club.....Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.....Plainview, Tex.	268
WSAW	John J. Long, Jr.....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WSAY	Port Chester Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop.....Pomeroy, Ohio	258
WSB	Atlanta Journal.....Atlanta, Ga.	429
WSL	J. & M. Electrical Co.....Utica, N. Y.	273
WSY	Alabama Power Co.....Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co., Fall River, Mass.	248
WTAC	Penn Traffic Co.....Johnstown, Pa.	360
WTAF	Louis J. Gallo.....New Orleans, La.	268
WTAG	Kern Music Co.....Providence, R. I.	258
WTAH	Carmen Ferro.....Belvidere, Ill.	236
WTAJ	The Radio Shop.....Portland, Me.	236
WTAL	Toledo Radio & Electric Co.....Toledo, Ohio	252
WTAM	Willard Storage Battery Co.....Cleveland, O.	390
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son.....Osseo, Wis.	254
WTAR	Reliance Electric Co.....Norfolk, Va.	280
WTAS	Charles E. Erbstein.....Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co..Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co...Tecumseh, Nebr.	360
WTAW	Agricultural and Mechanical College of Texas, College Station, Tex.	280
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcast. Sta., Oak Park, Ill.	283
WTAZ	Thomas J. McGuire.....Lambertville, N. J.	283
WTG	Kansas State Agri. Col.....Manhattan, Kans.	360
WWAB	Hoenig, Swern & Co.....Trenton, N. J.	226
WWAC	Sanger Bros.....Waco, Tex.	360
WWAD	Wright & Wright (Inc.)....Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley.....Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAO	Michigan College of Mines.....Houghton, Mich.	244
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	Detroit News.....Detroit, Mich.	517
WWL	Loyola University.....New Orleans, La.	280

Canadian Stations

CFAC	The Calgary Herald.....Calgary, Alta.	430
CFCA	Star Publishing & Printing Co.....Toronto, Ont.	400
CFCF	Marconi Wireless Telegraph Co. of Canada, Montreal, Que., Canada	440
CFCH	Abitibi Power & Paper Co..Iroquois Falls, Ont.	400
CFCJ	La Cie. de L'Evenement.....Quebec, P. Q.	410
CFCK	Radio Supply Co., Ltd.....Edmonton, Alta.	410
CFCL	Centennial Methodist Church....Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd.....Calgary, Alta.	440
CFCO	Semmelhaack-Dickson, Ltd.....Bellevue, Que.	450
CFCQ	Radio Specialties, Ltd.....Vancouver, B. C.	450
CFCR	Laurentide Air Service, Ltd.....Sudbury, Ont.	410
CFCW	The Radio Shop.....London, Ont.	420
CFDC	Sparks Co. .....Nanaimo, B. C.	430
CFQC	The Electric Shop, Ltd.....Saskatoon, Sask.	400
CFRC	Queens University .....Kingston, Ont.	450
CFUC	University of Montreal.....Montreal, Que.	400
CFXC	Westminster Trust Co...New Westminster, B. C.	440
CHAC	Radio Engineers.....Halifax, N. S.	400
CHBC	The Albertan Publishing Co.....Calgary, Alta.	410
CHCB	Marconi Wireless Telegraph Co. of Canada, Ltd., Toronto, Ont.	440
CHCD	Canadian Wireless & Elec. Co., Quebec, Que.	410
CHCE	Western Canada Radio Supply..Victoria, B. C.	400
CHCL	The Vancouver Merchants Exchange, Ltd., Vancouver, B. C.	440
CHCM	Riley & McCormack, Ltd.....Calgary, Alta.	440
CHCS	The Hamilton Spectator.....Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd.....Montreal, Que.	341
CJCA	The Edmonton Journal, Ltd.....Edmonton, Alta.	450
CJCM	J. L. Phillipe Landry.....Monti Joli, Que.	400
CJGC	London Free Press Printing Co....London, Ont.	430
CJCD	The T. Eaton Co., Ltd.....Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.....Vancouver, B. C.	420
CJCI	Maritime Radio Corp., Ltd.....St. John, N. B.	400
CJCN	Simons Agnew & Co.....Toronto, Ont.	410
CJCX	Percival W. Shackleton.....Olds, Alta.	400
CJSC	The Evening Telegram.....Toronto, Ont.	430
CKAC	La Presse Publishing Co., Ltd., Montreal, P. Q.	425
CKCD	Vancouver Daily Province.....Vancouver, B. C.	410
CKCE	Canadian Indp. Telephone Co.....Toronto, Ont.	450
CKCH	Canadian National Railways.....Ottawa, Ont.	435
CKCK	Leader Publishing Co., Ltd.....Regina, Sask.	420
CKCO	Dr. G. M. Geldert (For Ottawa Radio Assn.), Ottawa, Ont.	400
CKCX	P. Burns & Co., Ltd.....Calgary, Alta.	440
CKOC	Wentworth Radio Supply Co....Hamilton, Ont.	410
CKY	Manitoba Telephone System....Winnipeg, Man.	450
CFYC	V. W. Odlum.....Vancouver, B. C.	400

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower)	2,600
8AJ	Paris	1,780
ESP	Paris	450

Cuban Stations

PWX	Cuban Telephone Co.....Habana	400
2DW	Pedro Zayas .....Habana	300
2AB	Alberto S. de Bustamante.....Habana	240
2OK	Mario Garcia Vélez .....Habana	360
2BY	Frederick W. Borton.....Habana	260
2CX	Frederick W. Borton.....Habana	320
2EV	Westinghouse Elec. Co.....Habana	220
2TW	Roberto E. Ramirez.....Habana	230
2HC	Heraldo de Cuba.....Habana	275
2LC	Luis Casas.....Habana	250
2KD	E. Sanchez de Fuentes.....Habana	350
2MN	Fausto Simon .....Habana	270
2MG	Manuel G. Salas.....Habana	280
2JQ	Raul Pérez Falcon.....Habana	150
2KP	Alvaro Daza .....Habana	200
2HS	Julio Power .....Habana	180
2OL	Oscar Collado .....Habana	290
2WW	Amadeo Saenz .....Habana	210
5EV	Leopoldo V. Figueroa.....Colon	360
6KW	Frank H. Jones .....Tuinucu	340
6KJ	Frank H. Jones.....Tuinucu	275
6CX	Antonio T. Figueroa.....Cienfuegos	170
6DW	Eduardo Terry .....Cienfuegos	225
6BY	José Ganduxe .....Cienfuegos	300
6AZ	Valentin Ulivarri .....Cienfuegos	200
6EV	Josefa Alvarez .....Caibarién	225
7AZ	Pedro Nogueras .....Camaguey	225
7BY	Salvador Rionda .....Camaguey	350
8AZ	Alfredo Broocks .....Santiago de Cuba	240
8BY	Alberto Ravelo .....Santiago de Cuba	250
8FU	Andrés Vinnet .....Santiago de Cuba	225
8DW	Pedro C. Anduz .....Santiago de Cuba	275
8EV	Edurado Mateos .....Santiago de Cuba	180
8GT	Juan F. Chibas.....Santiago de Cuba	260

High Lights in Radio Development

Testing head set in the C. Brandes' laboratories

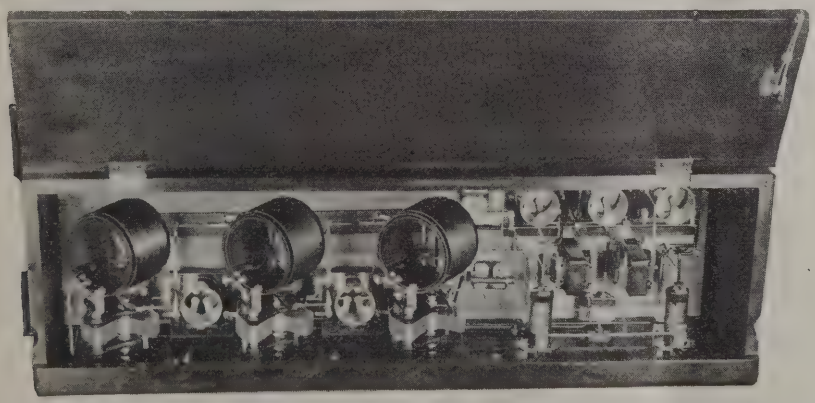
THIS MONTH

Announcing Trains—
A New Storage Battery—
A Ten-Year Lease—
Matching Tone Quality—
On a Canadian Trap Line

THE Interboro Railroad of New York has adopted the Callophone amplifying system for announcing trains at the busy express stations. Its premièrè appearance took place at Times Square station, the busiest station of the entire line, and probably of any railroad system in the world. This is the culmination of many other installations in commercial houses which have given the Callophone a great deal of prestige.

ROBERTS Radio Storage "B" Battery Company and the Todd Electric Company, make an alkaline "B" Battery with a unique arrangement of test tubes for cells, some Edison elements, yards of heavy pure nickel wire and a solution of Potassium Hydroxide (Potash). The battery has a capacity of 1,500 milliamperes and it is estimated can be recharged for only 5 cents. The Roberts "B" battery has 2 switch levers which give instant voltage changes upon a series of taps, giving a voltage range of from 16, 22, 44 and 140. The Todd is also tapped off. The sets are portable and are mounted in well-built mahogany finished cabinets which tend to give them an extremely neat appearance.

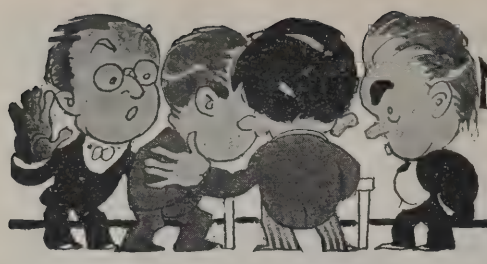
THE world's first annual international exposition will be held at Madison Square Garden, New York City, September next. This radio show will open Monday, September 22nd, and continue until Sunday, September 28th. It will be held under the auspices of the newly organized Radio Manufacturers' Show Association, composed of sixty of the most prominent American radio manufacturers. U. J. Herrmann and James F. Kerr, the well-known theatrical managers, who made such a gigantic success of the annual Chicago radio show, will be Managing Director and General Manager, respectively. There will also be an advisory board made up of E. B. Mallory, Chairman of the Radio Division of the Associated Manufacturers of Electrical Supplies, Paul B. Klugh, Executive Secretary of the National Association of Broadcasters, and Calvin Harris, the pioneer radio publicity expert. The Radio Manufacturers' Show Association will hold three great expositions next season which will probably revolutionize the show end of the business. The first will be held in New York, September 22 to 28, the second will be held in Chicago at the Coliseum, November 18 to 23, and the third will take place on the Pacific Coast early in 1925. The Board of Directors of the R. M. S. A. has taken an exclusive ten-year lease on Madison Square Garden for its annual and international radio show which will be held there every Fall until 1934. The Association has also taken over the Chicago Coliseum for a like period, and another ten-year lease is being negotiated on the Western exposition building. The new organization which is heavily financed is indeed a permanent institution which promises to be of great benefit to radio in general. The outstanding feature next season will be the introduction of foreign exhibits. There will also be a series of ultra-important public experiments and demonstrations for the purpose of bringing to light and testing out new radio inventions and theories. In addition to awarding suitable prizes to all successful inventors of the show management will also endeavor to assist them to market their inventions to the best possible advantage, gratis. Another interesting feature will be the Amateur Builders' Contest which will surpass all former competitions of the kind. The decorative equipment of the coming exposition will be the most elaborate ever built for an American trade show of any sort. Manager Kerr has opened headquarters at the Hotel Prince George, 14 East 28th St., New York City, where he will remain with his personal staff until September 15th.



A five tube Neutrodyne in which Fil-Ko-Stats have replaced the usual wire rheostats for filament control. This set, operating in Harrisburg, Pa., receives California stations nightly, often while the locals are operating and always when they have shut down

THE manufacture of reliable radio head sets is marked by test after test, and the greatest possible accuracy must guide each succeeding operation from the time the receiver cut is fashioned until the completed headset is finally passed for shipment. Minute currents of the order of one-millionth of an ampere will make audible sounds in a really sensitive headset, and the fact that it is possible to hear them seems almost incredible. To produce

(*Continued on page* 88)



NEW APPLIANCES AND DEVICES

Carter Inductance Switch

THE Carter Inductance Switch made by the Carter Radio Co., does away with the difficult job of mounting and soldering to switch points. It is only necessary to drill one hole in the panel. All contacts are mounted back of the panel, only the knob and dial being exposed on the front of the

panel. It has a contact arm which fits into a depression in the combination contact and solder terminal. A slight "click" sound indicates that a positive connection has been made with but one terminal instead of between two terminal contacts, as is usually the case.

The terminals can be soldered and all connections made before the switch is mounted. This makes a much simpler installation. The contact arm is fitted with a clock spring type of pigtail which eliminates the undesirable sliding contact.

In place of the usual small knob and large dial, the Carter Inductance Switch is furnished with a large tapered knob dial which shows at all times the exact position of the contact arm. There are 15 contacts, but by means of an adjustable stop any number of contacts up to 15 may be used and the balance left idle.

Durham Variable Resistance

LITTLE Omega Durham, the unique trade figure which has helped to introduce the Durham line of variable resistances is familiar to nearly every radio fan.

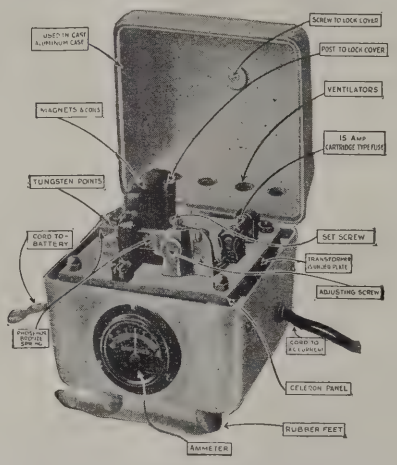
These grid leaks fit the standard grid leak condenser base and can be mounted so that the plunger can be operated from the panel and are adapted to all circuits. It is made in 3 values—1,000 to 100,000 ohms; 0.1 to 5 megohms, and 2.0 to 10 megohms. These products are manufactured by Durham & Co., Philadelphia.

Natann Battery Charger

THE Natann Charger, manufactured by the Natann Mfg. Co., operates on the vibrator principle, and rectifies a suitably stepped-down voltage of alternating current by making and breaking the circuit at the proper intervals, accepting only one side of the alternating current wave. It has an initial charging rate of 8 amperes, from an input current of 110 volts, 60 cycles. This rate tapers as the battery takes the charge.

The case is of polished cast aluminum, mounted on rubber cushion feet.

The interior working parts are mounted on a Celoron panel, and are made of substantial, well-fitted and finished brass castings. The springs are phosphor bronze. Beneath the panel is an oversize transformer, which operates with a minimum temperature



rise. The ammeter body is also placed under the panel, and the dial opens to the front side of the case.

Freshman Double-Adjustable Crystal Detector

CONSIDERABLE interest has been aroused by the New Freshman Double-Adjustable Crystal Detector, which has been found ideal for reflex and crystal circuits.

The Freshman detector unit differs from other units in having a knob which can be brought through to the panel and, when turned, varies the crystal contact with the loop whisker, thus permitting the operator to find sensitive spots quickly without disturbing the tension on the whisker spring.

It has an insulated housing for the crystal, and a lever at the base unit adjusts the contact tension of the whisker which operates in concentric revolutions about the face of the crystal, thus covering every point on the crystal as it is adjusted by a little knob on the panel.

A special crystal of pure natural ore which will withstand voltages as high as 130 without burning out, is used. The crystals themselves are replaceable by fresh units which are sold mounted.

The Bradleyohm

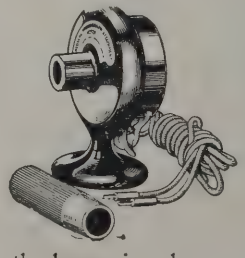
THE Allen-Bradley Co. has added another item to their increasing list of radio products known as the Bradleyohm. The Bradleyohm is an adjustable resistor which is varied over a wide range by applying or removing pressure on the two columns of treated discs by means of an adjusting knob.

The Bradleyohm is admirably suited for such purposes as providing an adjustable resistance across the audio-frequency transformers to reduce distortion; for providing resistors to be used in coupling radio frequency or audio-frequency resistance amplifiers; for adjusting filter couplers of super-heterodyne circuits, and for adjusting push-pull amplifiers.

It is made in three sizes with the following ranges: Bradleyohm 10—10,000 to 100,000 ohms; Bradleyohm 25—25,000 to 250,000 ohms; Bradleyohm 50—50,000 to 500,000 ohms.

"Red Seal" Phonograph Attachment

THE Manhattan Electrical Supply Company is offering for sale a new phonograph attachment under their well-known trade mark "Red Seal." This consists of a special Red Seal receiver attached to a heavy non-resonant metal base with air chamber and diaphragm especially designed



to operate the large air column of a reproducing horn. Attachment is made to the tone arm of the phonograph by means of a soft rubber tube.

The Red Seal Phonograph Attachment is sensitive to faint signals and re-creates musical programs with the same fidelity as the well-known Red Seal Headset.

Medium Frequency Transformer

THE design of a transformer for medium frequency amplification is quite different from the usual amplifying transformer design. Audio frequency transformers must have a considerable volume of iron while the short wavelength radio frequency trans-

formers usually have no iron at all. As the medium frequency transformer falls between both of these limits the natural tendency has been to make it merely a modification of one of these types. It is evident that such a method does not produce a carefully designed instrument.

The type 271 Transformer has been designed by the General Radio Co. as an instrument distinct in itself and particularly adapted to the service required of it. It is shielded both electrostatically and electromagnetically, thus greatly reducing reaction between stages and permitting the associated tubes to be operated at full capacity. Its peak frequency is 30 K.C. (10,000 meters).

Magnavox Electro-dynamic Reproducer

THE new model Magnavox Reproducers R3 and R2 contain refinements making for increased efficiency as well as economy of operation.

Current consumption has been so reduced that the new models can be operated at any point between .1 ampere and .6 ampere when supplied with six volts.

The volume control is a true electrical switch which permits the user to control

current consumption as well as adapt the reproduction to every possible time, place and condition.

Other improvements relate to the diaphragm, the movable coil, and also the external finish and appearance of the instrument.

Radio Cabinet

THE Radio-Spinet, designed by the Bay View Furniture Co., in all essentials is the ideal radio cabinet because of its practical features and its desirability as a beautiful piece of modern furniture.

The Radio-Spinet has ample room in the front compartment to nicely accommodate most of the popular receiving sets, and is by no means limited to any one kind.

All batteries (both wet and dry), charger, and wires are contained in a rear compartment, concealed from view, but instantly accessible through a large size lid which opens up all the way and exposes the entire interior.

Two large roomy drawers, one at each end, provide for the accommodation of all those miscellaneous items which accumulate around the radio—note-books, pencils, programs, clippings, extra tubes, head phones, etc.

The top measures 23 by 45 inches. The receiving set compartment measures 32 inches long, 10¼ inches wide and 7⅞ inches high. The rear battery compartment meas-

ures 32 inches long, 9¾ inches wide, and 11¼ inches deep. The top lid measures 32¼ by 10 inches and opens up, on hinges, all the way.

The back panel has openings for insertion of wires. Other openings can be drilled in as needed.

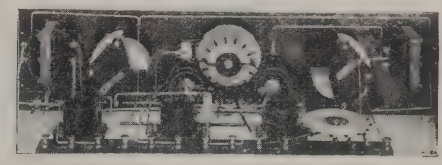
Made of combination mahogany with top and front of solid Honduras mahogany—the best obtainable. Finished in the popular dull-rubbed brown mahogany or in the waxed antique old mahogany with its soft highlights.

Trirdyn Receiver

THE newest addition to the Crosley line, is the Trirdyn 3-R-3 announced on the third anniversary of the corporation. Four important principles are accomplished in receiver design in the Trirdyn: tuned radio frequency amplification with the first tube; Armstrong regenerative detector action with the second tube; reflex amplification by employing the first, or radio frequency tube as an audio amplifier and one-stage of audio frequency with the third tube. These factors combined in the particular arrangement of this receiver, give signal strength of a receiver utilizing five tubes.

The Trirdyn will not re-radiate when receiving broadcasting station signals, due to the fact that the antenna is very loosely coupled to the secondary circuit and a non-oscillating radio-frequency amplifier is employed before the regenerative detector, as a barrier to prevent oscillations generated by the detector upon reaching the antenna.

The primary or antenna circuit of this set is aperiodic or untuned, making it possible to calibrate the secondary circuit and the tuned radio frequency amplifier in terms of wave-length, thereby enabling the receiver to be accurately adjusted to the signals of any broadcasting station from a calibration table or curve sheet.



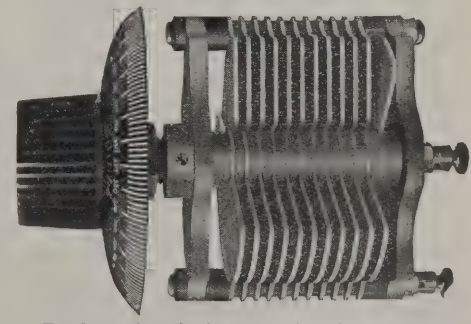
The set is selective because it employs tuned radio frequency, loose-coupled antenna and a tuned secondary. It is possible to receive the distant stations while local stations are transmitting. For example, in Cincinnati it is possible to tune in KDKA which is only seventeen meters higher in wave length than WLW, while the latter station is in operation.

It operates satisfactorily with a small indoor antenna with loud-speaker volume, and good results have been obtained using only a ground connection. It requires a detector and two amplifier tubes of standard type and satisfactory results are obtained when dry cells are employed for lighting the filament, but the volume will be greater with 6-volt tubes.

Cruver Condenser

THE Cruver Manufacturing Company have just put out a new condenser which cuts down the inefficient capacities by means of mounting the stator plates on two rods instead of the three usually used and thereby have reduced the losses to a negligible quantity. A 23-plate condenser showed the same reading at maximum capacity and 290 meters as the standard used, which was stated to have a loss of only seven one-thousandths of one per cent. at a capacity of .001 mfd.

This condenser has two scales on one dial. When the knob is turned either to the right or the left, the vernier plate lines up with the rotor plates and the vernier index reads zero. When the group plates are set for the coarse adjustment the reading shows on the large scale. The knob is then turned in the opposite direction and the fine adjustment is read on the inner scale, thus an accurate log can be obtained, which facilitates tuning in the required station.



Perfect electrical connection between stationary and movable plates is secured without pigtail connections and body capacity is eliminated entirely when the rotor plates are grounded. It can be mounted by means of one nut in a few seconds after the hole for the shaft has been bored.

The D-Coil Receiver

(*Continued from page 36*)

fore if dry cell "B" batteries are used it is advantageous to keep the plate voltage as low as possible to prolong the life of the "B" batteries. The grid return of the two audio-frequency amplifier tubes is connected to the negative filament terminal through a 4.5 "C" battery. This holds the grids 4.5 volts negative and is another aid in prolongation of "B" battery life, although its principal function is to hold the grids at just such a negative value that maximum amplification with minimum distortion will be produced from the audio amplifier. This value of "C" battery voltage is the proper one to use when 90 volts is applied to the plates and if the plate voltage is increased the "C" battery voltage should be increased. The plate circuit of the second audio frequency amplifier tube is connected to the 90-volt tap of the "B" battery through a single or open circuit jack. The only time you will ever use this jack is when you wish to plug in the loud speaker. The volume available here is much too great for the phones. Thus when the loud speaker is removed from the circuit and the phones are plugged in on the detector or the first step, the plate circuit of the second and last tube is open and therefore is not drawing plate current and this also helps to prolong the life of the "B" batteries.

No Stabilizing Resistance Needed

It is to be noted that there is no stabilizing resistance shown in the circuit and none is needed. The circuit is absolutely stable without the application of stabilizing resistances or neutralizing condensers and is therefore simpler in construction, easier to put into operation and much more efficient in operation.

It is necessary to have a good ground. I would not say that a steam pipe ground was sufficient. It is necessary to either have a water pipe ground or an electric light ground. Of course, that theory applies to all receivers, but I have noticed it more with this type of receiver than any other. Without a good ground the receiver will not give the results by a long ways that it is capable of giving.

Will Operate Without Antenna

It will function very nicely without an antenna or loop. With a receiver of this type which I made up and which was located at 207th Street and Broadway, New York City, stations at Chicago, Cleveland, Cincinnati, Pittsburgh, Hastings, Nebraska, and many others were brought in with only a ground connection to the water pipe and using no antenna connection whatever. I have tried this receiver out and am firmly convinced that it is one of the most efficient receivers that can be built, being exceeded only by the super-heterodyne and Regenoflex receivers.

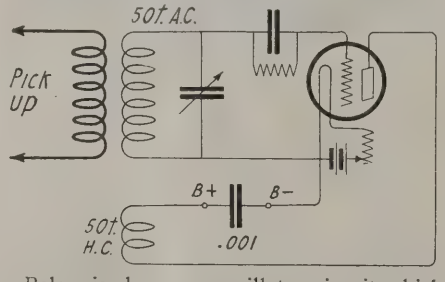
In this circuit the radio-frequency amplification has not been carried to the maximum that is possible, and I think it safe to assume that at least one or two more stages could be put in ahead of the first tube. I haven't tried it out, however. These additional stages of radio-frequency amplification would probably have to be untuned as it would not be advisable to bring any more tuning elements into the circuit. Three is enough. Regarding this circuit that I have described, you will find that if you bring in KFKX at Hastings, Nebraska, with the dials all set at 15 degrees, you will always find him at that point and therefore when you have your dials calibrated in stations it will always be an easy matter to set the dials quickly for any station that you wish to receive.

Information Desk

(*Continued from page 68*)

Oscillator Circuit

E. F. Jones of Detroit, Mich., says, "I would like to have you give me a diagram for a good oscillator circuit that will cover the broadcasting wave band. I have built myself a superheterodyne and have used up to the present time the Hartley oscillator circuit with a UV-201-A tube. I have had a great deal of trouble in trying to make the tube oscillate over the entire wave band, having found it necessary to force the filament and use high plate voltages.



Below is shown an oscillator circuit which will oscillate with the same degree of efficiency over the entire range of the variable condenser. The Hartley circuit is unsuitable for your use and is particularly hard to adjust for maximum oscillation even at one set frequency such as when used in transmitting sets.

How You Can Help Us to Help You Use the Information Desk

Not long ago we received from one of our readers, a letter asking several questions. This letter came so near to being our ideal that we are printing a copy of it here. You will note that the writer made his questions short and to the point; gave what details were necessary to our understanding of his receiver; numbered his questions and left a space below each one where we could very easily jot down the answer and send his original letter back to him with both the questions and answers together. We hope our readers appreciate the time and labor which this method saves in conducting this department. Hereafter all letters to us in this general form or a similar one will receive priority in being answered.

"I am about to build the 5-tube Neutrodyne Receiver shown in Fig. 9, p. 57, Wireless Age for April, 1923. I have searched the lot and no hook-up appeals to me as this one does; but there are a few points I would like to have cleared up. Using the attached envelope would you please set me right in the following:

If you were building this set and had on hand a new Remler variometer and two General Radio A. F. transformers would you

1. *Use the variometer* ☐
2. *Leave it out* ☐
3. *Use the General Radio transformers* ☐
4. *Use 1 rheostat for the two A. F. tubes* ☐
5. *Use 1 rheostat for the two R. F. tubes* ☐
6. *Use 1 rheostat for each tube* ☐
7. *Would a battery of dry cells connected to furnish 6 volts operate, while they last, five 201A tubes as well as a storage battery?* ☐
8. *Nearly as well* ☐
9. *Not nearly so well* ☐

DX Reception

J. A. White of New York City, encloses a diagram of his receiver and asks us how he can get distance. Getting distant stations depends on many things; your location, your antenna, your ground, the condition of your batteries, your familiarity with set and probably last of all, the set itself. Of these mentioned items, familiarity with your particular receiver is most important. This experience cannot be gained by a week's listening-in, but takes months. We know of one type of set in particular that we have operated on which we were able to get very good results, yet in the hands of anyone else the set might as well have been "dead." Learning the proper adjustments of the dials, being able to "feel" for stations, and sensing a resonant circuit, that is tuning.

"The Air Is Full of Things You Shouldn't Miss"

REQUESTS coming in from radio dealers for permission to make use of the slogan, "The Air is Full of Things You Shoudn't Miss," has led the National Carbon Company, creator of the slogan, to define the position taken with all such inquiries.

The company says: "The National Carbon Company has spent a large sum of money in popularizing the slogan, 'The Air is Full of Things You Shouldn't Miss' as applying everywhere and at all times to Eveready Radio Batteries. As a result, the slogan became distinctly associated in the minds of everybody interested in radio with the line of Eveready Radio Batteries manufactured by the National Carbon Company.

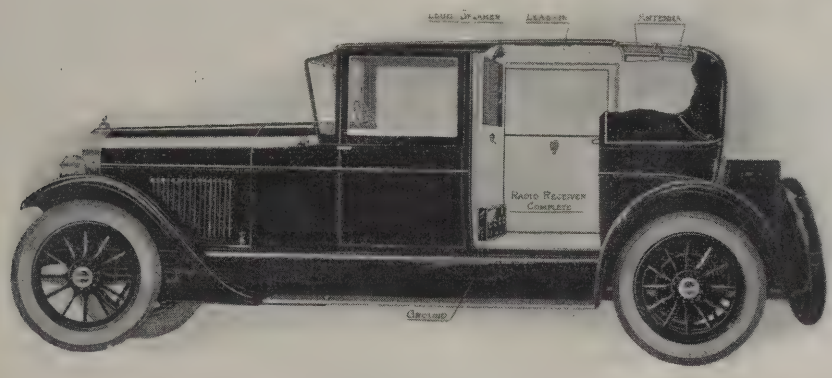
"We have felt it necessary to refuse and we will continue to decline permission to dealers to use it except in advertising Eveready Radio Batteries. For such purposes they are welcome to it in the public prints, in windows and in counter display. But it must at all times be associated with Eveready Radio Batteries only."

Radio for Boatman, Motorist or Hiker

(*Continued from page 26*)

would pass through many towns and cities where small broadcasting stations are situated. We venture to predict that on a trip of this kind, you would probably hear a score of stations which you never had the opportunity to hear before, simply because they were too weak for you to bring in at home. Such a trip would not only give pleasure from its scenic side, but also from the viewpoint of radio.

Of course in neither the motor boat nor the automobile is it possible to receive while the engine is running. Every time your spark plug fires, you have a miniature transmitting set in action, and in a six or eight cylinder car, these explosions occur so often that it would be almost impossible to receive anything else. On some of the larger boats this might be avoided by removing the set as far away as possible, but in most cases trouble may ensue.



A radio-equipped automobile

One enthusiastic radio fan used a device on his boat to overcome this trouble. He got a fifty-foot length of rubber covered copper wire and sealed up the end with a test tube filled with paraffin. When the boat was in motion, this wire was thrown over the stern and broadcasting was actually received, despite the fact that the aerial was under water. The rubber covering was, of course, waterproof, while the test tube prevented leakage at the end of the wire.

Such a device as this might work out quite well in some cases, but it is a subject which is not to be counted upon too much.

In the automobile this trailing wire cannot be used, of course, and in most cases it will be found that the only time radio listening can be indulged in will be when the engine is not running. There may be some cases where reception has been accomplished in close proximity to a running gasoline engine, but the writer has never yet seen a really successful demonstration.

Automobile reception will limit itself to evenings spent in hotels and possible noonday stops for lunches. The rest of the time the set will be of little use, but it will certainly be enjoyed in a real automobile camping party, where the nights are spent in the open. However, there are some things to be remembered. The automobile is considerably shorter than the motor boat and successful aerial installation on the car is seldom accomplished except for stations only a few miles distant or with quite powerful receiving sets.

This makes it necessary to erect some kind of temporary aerial at each camping place and again we will have to resort to the spool of wire. For this purpose, nothing is better than what is known as a deep sea fishing reel. These come in large sizes and it is possible to wind considerable flexible wire on one. The usual seven strand aerial wire will prove too bulky and it is advisable to get some smaller size.

If a rather heavy sinker is attached to the end of this wire and it is then thrown over the limb of some nearby tree, a suitable aerial will be the result. Except in damp weather, the fact that no insulators are used will make but little difference in the strength of the received signal. Of course it may make a little difference on long distance stations, but for all ordinary work it will prove to be quite satisfactory.

By throwing the sinker over the tree branch and then walking off for fifty or so feet, to the set, a good stretch of wire will be secured. Of course the ground should be made in damp earth, if possible, and a short length of number fourteen wire attached to a length of iron pipe will be sufficient. The pipe should be about two feet in length and driven into the earth for about three-quarters of its length. If you happen to be camping near a body of water, then weight a length of wire and throw it out from the shore.

A careful record kept of the weather during last summer, proved beyond the shadow of a doubt that the nights when really heavy static is heard, are far below the usual idea of the subject. You will find that the good nights average about six out of seven.

This summer is going to be radio from start to finish, and right now is the time to start in your preparations.

The Boy Scouts of America

(*Continued from page 39*)

With the American Morse Code:

1. Commercial telegraph operator.
2. Stock broker operator.
3. Telegraph and telephone engineer.
4. Railroad operator.
5. Train dispatcher.

With the Continental Morse Code or Both:

6. Ship radio operator.
7. Land station operator.
8. Broadcast station operator.
9. Cable operator.

Boy amateurs played one of the most prominent parts in the World War, which found them ready to give their services to Uncle Sam. These boys, many of them, had but a few years previous been Boy Scouts. And, moreover, this great radio we have today (I refer to broadcasting) is likewise directly the results of the vision, enthusiasm and imagination of former Boy Scouts.

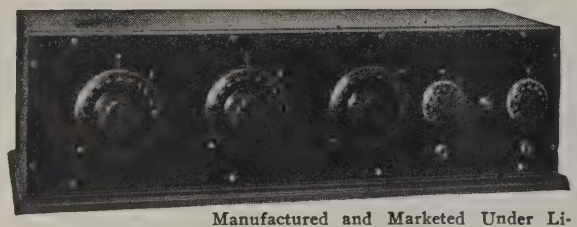
For when the boys came back they, as well as the thousands who were taught radio in the Army and Navy, turned once more to amateur experimentation. They added radio telephony to their telegraph experiments and message exchange. They talked back and forth, first only a few blocks, then a few miles and finally from city to city.

It was the boys of the Nation that helped largely to make this great art what it is today. And it goes without saying, of course, that many of these same boys are today leaders in the industry. I know two that are on the road to become millionaires. One of them was once a Boy Scout.

Recently, while on a business trip, I watched the farm houses as the

Pathé
REG. U.S. PAT. OFF.

"MINUTE MAN"
Radio Receiving Set
INCORPORATING
Pathé Type "P" Phusiformers



Manufactured and Marketed Under Licensed Agreement, Patent Pending

PRICE
$125.00
(tubes, batteries extra)

THE new five-tube "Minute Man" was specially constructed to meet the demand for a receiving set embodying these features:

No Squeals
Tune in either with a loud speaker or head phones without any squeals or rasping. At any setting of the dials there is none of this unpleasantness so prominent in many other sets.

Pure Tone
The reproduction of broadcasting by the "Minute Man" is remarkable for its clarity and sweetness of tone, increasing your enjoyment a hundredfold.

Simplicity
The "Minute Man" is simplicity itself to operate. The dials can be adjusted by a child—and the set is "Fool-proof." The dial settings are constant. A station once located can always be brought in without preliminary searching.

Genuine mahogany cabinet and panels.
Gold engraved dials.

Free Booklet
Booklet "How to Build a 5-Tube Receiver, Using Three Phusiformers," sent free on request. Address Dept. A22.

Dealers and Jobbers
Write Dept. A22
For catalogue and prices of Pathé line.

PATHÉ PHONOGRAPH & RADIO CORP.
20 GRAND AVENUE, BROOKLYN, NEW YORK

train whizzed past and there must have been an aerial on top of every fifth farm house I saw. Now I know enough about the farmer to know that they have not the time to install these sets. Who did it, then? Boys, of course, and many of them got their training in radio through Boy Scout activities.

And now a few words about the meaning of radio to this great Boy Scout movement which today obtains in almost every big nation of the world.

The call to rally has long been sounded by means of the Boy Scout whistle. Its shrill blast has echoed throughout hundreds of camps, and hiking parties have been guided by its note. Yet its feeble signal scarcely reaches the extremities of the camp. Reinforced by the tremendous amplifying ability of a powerful broadcasting station, however, and the same signal will call a nation of listening Scouts to attention. Thus, through the agency of radio, Scouts in cities, villages and hamlets are welded together into a single group, and 500,000 Scouts may hear simultaneously the voice of their leader and Honorary President, the President of the United States.

I believe radio broadcasting will some day accomplish even more than this. Already programs broacast from the United States reach out to foreign lands. Various refinements in transmission and reception coupled with increased power will bring about reliable broadcasting between such countries as America, France, England. When Baden Powell, speaking from a London station, is plainly heard in all parts of America, and Dan Beard, one of America's leading Scouts, returns a salute from the United States, radio will prove a still more powerful vehicle for promoting the Boy Scout movement.

Of course, there is only one ether, one vast highway, which must support the burden of every conceivable message hurled through space, whether it be a broadcast concert or a radio telegraphic wave. We must use this ether with the utmost respect for the rights of others. This great common highway is divided into "lanes," which are policed by the radio inspectors of the Department of Commerce in the same manner as our automobile and pedestrian traffic on the streets. With the rapid growth in the number of broadcasting stations in the United States, this broad highway had to be divided into many narrow wavelength bands to make a place for all until today few additional divisions are possible. If through selfishness, lack of care or ignorance, amateur operators violate the regulations governing the use of these wavelength roads, the foundation upon which the entire radio structure rests will collapse.

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Complete RCA *Service*
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Wholesale Only
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THE PHILADELPHIA ELECTRIC COMPANY SUPPLY DEPT.
130-32 So. Eleventh St.
Philadelphia

MISSOURI

WESTERN RADIO CO.
Dependable Merchandise
from
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A Complete Stock of R. C. A. Merchandise Always on Hand
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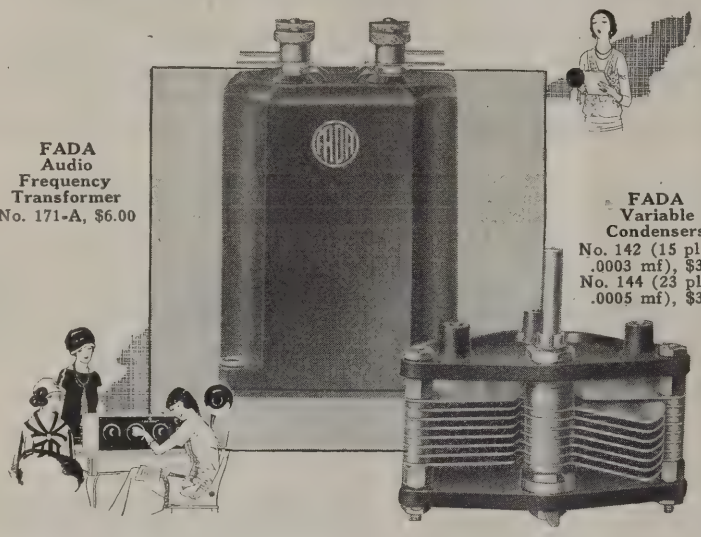
Electrical Jobbers
CHARLESTON, WEST VIRGINIA

FADA

Announces a New Audio Frequency Transformer and New Variable Condensers



FADA Audio Frequency Transformer No. 171-A, $6.00

FADA Variable Condensers No. 142 (15 plates .0003 mf), $3.00 No. 144 (23 plates .0005 mf), $3.50

IN KEEPING with its established policy of producing only the finest of radio apparatus, F. A. D. Andrea, Inc., announces a new Audio Frequency Transformer suitable for all circuits, and particularly adapted to the audio stages of Neutrodyne receivers.

A high average amplification over all audio frequencies is the outstanding accomplishment of this new FADA transformer. Encased in bakelite with nickeled binding posts, it looks twice its worth. Try FADA Audio Transformers in your receiver and know what uniform and distortionless amplification really means.

—and now, new variable condensers

The name FADA on a condenser means just one thing—condenser satisfaction. The new FADA condenser is made in two capacities—15-plate, capacity .0003 micro-farads, and 23-plate, .0005 micro-farads; and each the exact capacity at which it is rated. Radio frequency losses are reduced to a minimum by special rotor wiping contact brushes. A true "low-loss" condenser with an efficiency exceeding that of condensers selling at much higher prices.

Dealers are now ready to supply FADA transformers and condensers.

F. A. D. ANDREA, INC.
1581 Jerome Avenue, New York

F. A. D. ANDREA INC. LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC. NEUTRODYNE UNDER ARTZ-LINE PATENT NO. 1450080 DATED MARCH 27 1923 OTHER PATENTS PENDING TRADE MARK REG. U.S. PAT. OFF.

Each listener, amateur and commercial operator has a definite responsibility which he must assume in order to preserve radio's usefulness. The Boy Scouts of America, an organization of 500,000 law-respecting young men, who daily demonstrate their regard for the rights of others and whose loyal devotion to the highest principles of citizenship have won for them the praise of the nation, have an important duty to perform to make radio of greater use to everyone. They should impress upon others the importance of observing strictly radio laws in general; they should instruct or warn those who, through ignorance or design, make trouble for their neighbors by sending amateur messages during the hours set aside for broadcasting, and report cases of violation to their local radio inspector; their advice guided by that of their Scout Masters should even extend into the home of the radio novice, who may not be entirely familiar with the operation of a receiver.

The Boy Scouts of America may thus create another field for their endeavors, which should prove extremely helpful in maintaining a well-organized radio system in America.

Radio in the Canadian Wilderness

(*Continued from page* 41)

As the fire burned out, the embers formed into glowing patterns that seemed to illustrate the broadcast music. Castles and forests, and Mediaeval faces were pictured there.

Even the guides were won over to the radio.

* * *

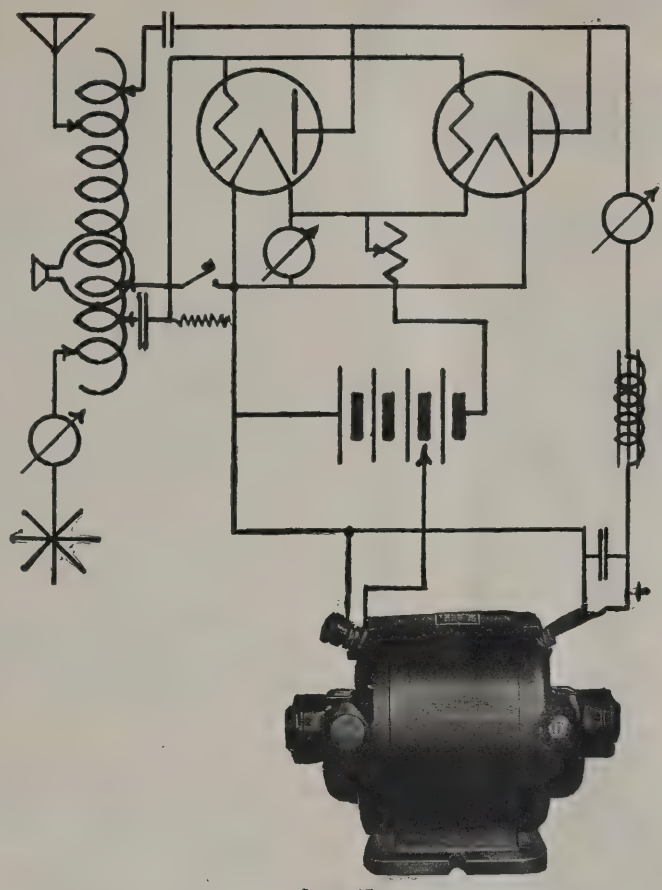
In the morning, we found two salmon and a lake trout spread on birchbark slabs that had been laid on the shore near our canoe.

Jacques explained that the Indian family across the lake had left them as a neighborly greeting. He said that custom forbade anyone going ashore at a camp until an invitation had been given.

Of course, Dr. Hobart and I wished to return the courtesy in some way. Jacques advised us that we should use discretion because the Indians appreciated a small gift; in fact, respected the White Men for their possession of that which the Indians would like to have. But should too much be given, the Indians would invariably demand more, and would very likely take it.

Doc suggested the radio. It was the one thing we could give them in plenty without danger. The Indians couldn't use the set if they did capture it.

A trip to the Indian camp was



Item 45

A FEW GOOD COMBINATIONS.

Item		Description			Recommended for
2	350 V	40 Watt			2-5 watt separate Fil. supply.
7	500 V	100 "			4-5 " with separate Fil. supply.
8	500 V	150 "			5-5 " 2 mod. 1 mast. osc.-2 osc. sep. Fil. supply.
13	1000 V	300 "	dbl. comm.		2-50 " with separate Fil. supply.
15	1000 V	500 "	"	"	3-50 " or 2-50 watt and 4-5 watt as speech amplifier and mast. osc. Sep. Fil. supply.
16	1000 V	650 "	"	"	4-50 " with separate Fil. supply.
20	1500 V	600 "	"	"	2 to 3-50 " with separate Fil. supply.
24	2000 V	500 "	"	"	1-250 " with separate Fil. supply.
26	2000 V	1000 "	"	"	2-250 " with separate Fil. supply.
31	500 V	100 "	10 V	60 Watt	same as item 7 but with Fil. supply.
35	1000 V	300 "	12 V	150 "	" " " 13 " " " "
41	2000 V	500 "	14 V	200 "	" " " 24 " " " "

Many other sets for various combinations of tubes. Special sets made to order.

TRADE **"ESCO"** MARK

MOTORS — DYNAMOTORS — GENERATORS — MOTOR-GENERATORS

Used by more than 150 Universities, Colleges, Research Labs., etc. Many Federal, State, County and Municipal Depts.

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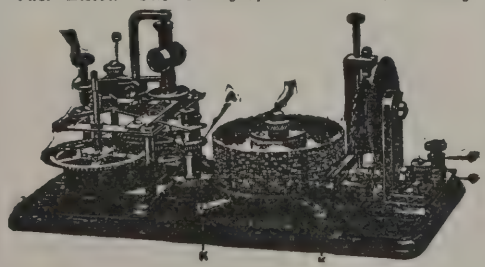
Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"



THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. **THE OMNIGRAPH** is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. **THE OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses **THE OMNIGRAPH** to test all applicants applying for a Radio license. **THE OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models.

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16B Hudson St. New York City

If you own a Radio Phone set and don't know the Code—you are missing most of the fun

$25 for $10

THE FAMOUS
THE ACOUSTICAL AMPLIFIER
BEL-CANTO
TRADE MARK
LOUD SPEAKER
PRICE $10
DELIVERED FREE TO YOUR DOOR

You can only buy the BEL-CANTO Direct from Us-the Manufacturers-We save you these three Profits-Distributor-Jobber-and Dealer.

GUARANTEE

Money back any time within ten days if dissatisfied. We further guarantee to the publication carrying this advertisement that each and every speaker will be sold on the above terms and the instrument will be exactly as offered in this issue.

7 Points of
BEL-CANTO SUPERIORITY

(1) Fiber Horn, Crystalline finish.
(2) Our own adjustable unit.
(3) Heavy metal base, eliminating top heaviness.
(4) All other metal parts heavy cast Aluminum highly polished.
(5) Height 22". Bell 10".
(6) Guaranteed one year against mechanical defects of any kind.
(7) No extra battery required, just plug in on the phone circuit.

Call at our factory, send us your check, money order, or pay the postman $10.00. Prepaid to any part of U. S. and Possessions.

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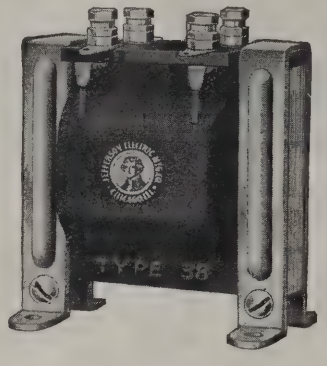
Pioneers

The trail blazers through their untiring efforts are always the pioneers of Industry.

The present day perfection of Radio Transformers is due in no small measure to the faithful and persistent efforts of Jefferson Engineers who designed and experimented with Audio Amplifiers long before Radio reached its present day popularity.

TRANSFORMER SPECIALISTS

These extra years of experience are reflected in the quality and performance of Jefferson Transformers.



The name Jefferson is associated by both professional and amateur Radioists as regards Radio, Intermediate and Audio frequency Amplification with extremely high quality.

The installation of Jefferson transformers in your set will assure you of a quality of Reception that is unparalleled. There's a Jefferson Transformer for every circuit.

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Radio is in its infancy. But it is a "mighty baby" and growing by leaps and bounds! Now is the time for YOU to enter this profession with its unlimited possibilities. We train you in a short time for the positions of Radio Operator or Radio Mechanic. New Radio Sales and Service Course. Radio Operators' correspondence course. State preference.

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Y. M. C. A. Radio Institute

149 East 86th Street New York

planned for the afternoon so that we could tune in on some broadcast station. During the morning, Doc and I explored the lake shore while the guides baked a blueberry pie.

Incidently, baking in the Northern wilderness is quite an accomplishment. Jacques made a deep bed of live coals, placed the pan over them, raised two logs over the pan, covered them with small rocks and then built a fire on the top. Was the pie good?

Juicy bacon on baked salmon with steaming tea and flap-cakes, topped with luscious blue-berry pie, the twang of pine and spruce in our nostrils!

All day we heard the *tom-tom* of the Indian drums across the lake. It beat in my head. The monotony of it finally aroused pent-up emotions within me that I had never suspected were my inheritance.

We paddled over to the Indian camp and waited just off shore. The chief walked down, saluted, and listened to Joe's explanation. He immediately welcomed us to the bosom of his camp.

Our Indian guide, Joe, acted as interpreter. The tribe we were visiting were, to say the least, incredulous of our "music box."

These Indians travel in family groups of thirty or forty. They are small in stature and resemble Japanese or Eskimos in feature. Tufts of hair protrude from unexpected points about their faces; from each corner of their mouths, usually on the lower lips, or frequently from their cheeks.

Their costumes consist of red toboggan hats, red-top socks, red sash, striped flannel shirts, and usually, khaki riding breeches.

The women are extremely shy. But the children, like all youngsters, stare unabashed.

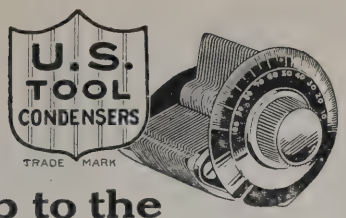
The Chief had some Kodak pictures of the family that a visitor had left. He brought them for display much in the manner of country folk, showing the unfortunate visitor the family album.

The children learn to carry packs as soon as they can walk. They also have small, half-size canoes. Carrying the tons of supplies from the trading post into the wilderness requires the service of all who can be enlisted.

While the women weave shirts, and prepare dried fish and meats, the men relay the supplies over the portages. They work hard on the portages—terribly hard. But they otherwise take life as it comes, leaving most of the responsibilities to the women.

When I managed to tune in CKAC, the Indians were delighted. Singing, talking, orchestral music—inconceiveable!

Late into the night we celebrated.



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Material and workmanship equal to the most exacting requirements of the latest circuits.

FOR Superheterodyne
Superdyne,
Inverse Duplex,
Four Circuit Tuner

USE Vernier Cap. .00057 Mfd. (24 Plate)
or Plain Cap. .00055 Mfd. (23 Plate)

Condensers of recommended capacity for all known circuits are also carried in stock by leading radio retailers.

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100% GUARANTEED

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RECEIVERS
THE ULTIMATE IN RADIO RECEPTION

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$1.25

Why pay $10.00 or more to have an aerial spoil the appearance of your home? Antenella eliminates all unsightly wiring, lightning arresters, etc., and precludes the possibility of dangerous grounding on a power line. It also stops "canary bird" re-radiation from nearby oscillating sets interfering.

ANTENELLA
is not only a real distance getter, but also overcomes troublesome static.

At your Dealer, otherwise send purchase price and you will be supplied postpaid.

Ask for circular A-16

Chas. Freshman Co. Inc.
Radio Condenser Products
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Eagle Neutrodyne Balanced!
RADIO RECEIVER

Licensed by Independent Radio Manufacturers, Inc., under Hazeltine Patent No. 1,450,080, dated March 27th, 1923, and other patents pending.

*E*VERYWHERE the EAGLE leads! Fine balance of tube capacities—perfect as the balance of the experienced structural iron worker. Quality, the sum total of infinite skill and years of experience. Until others can successfully duplicate the exceptional skill in balancing and testing of each receiver, there can be no real rival of the EAGLE. A product of "quality" rather than quantity production. Stations located instantly by turning dials *always* to the same points. Easy to operate as a phonograph. Unreservedly guaranteed.

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Over 200,000 small town circulation of the highest type

BRISTOL SINGLE CONTROL RADIO RECEIVER

Using Grimes Inverse Duplex System

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Most Simple to Operate

The set for those who want results with little effort. Anyone in the family can quickly learn to operate it because technicalities and guesswork are eliminated—One Control Dial does it all.

Does Not Interfere with Your Neighbor

Other close by reception is not disturbed when you tune in with this non-reradiating Receiving Set. It gives you a comfortable sensation of freedom to be able to change from one station to another knowing that you will not interfere with your neighbor's receiving.

Choice of Aerial or Loop

Where conditions make it difficult to install an outside aerial, as in congested sections of cities, good results can usually be had by using inside Loop. In fact, the directional feature of the Loop often brings in stations not possible with a stationary aerial.

Mounted in solid mahogany case with walnut finish, the Bristol Single Control Radio Receiver is handsome in appearance. The price is $190.00. Bulletin 3013-V describing this set will be mailed on request.

BRISTOL

TRADE MARK

AUDIOPHONE

REG. U. S. PAT. OFFICE

Loud Speaker

This is known everywhere as the Loud Speaker with the quality tone. Not only is the tone natural and without mechanical distortion, but is sufficiently big in volume to be easily heard in a large room or all through the house. Comes to you ready to use—no auxiliary batteries are required.

Made in three models:

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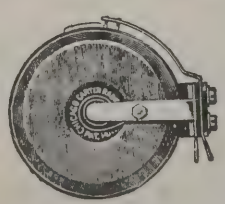
THE BRISTOL COMPANY, Waterbury, Conn.

CARTER VERNIER CONTROL RHEOSTAT



Eight exclusive Carter Features:
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Slight click indicates positive "off" position.
Heavy phosphor-bronze contact spring.
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Extra large tapered Knob and Pointer, one.
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Only one hole to drill in panel, mounts like jack.
Wide spaced solder terminals for connections.

Any dealer can supply

6 ohms - - - $1.50
20 or 30 ohms, 1.75

Carter Radio Co.
1802 REPUBLIC BUILDING
CHICAGO

The Indians danced. Our guides told stories of the trail. And at the end we all sat down to a venison feast. A truly royal feast in the heart of a wild dominion.

Chasing Squeals

(*Continued from page 59*)

If you have a filament volt meter take a glance at the voltage which you have across the terminals on the socket. You will note that with each tube there is a specified voltage for the filament at which this tube works best. In the case of WD-11's and WD-12's this voltage is 1-10th, with UV-199's it is exactly three volts and with 201-A's it varies from 4½ to 5 volts. Now in no case is the voltage of your battery exactly that which is applied to the filament terminals, or rather we should say that the voltage of your battery never reaches the tube intact. This is due to poor connections, resistance of wires, etc., which are beyond your control in most cases. So it becomes necessary to use a higher voltage battery than is necessary to feed the tubes at the socket terminals. For the WD-12 we use 1½ or 2 volts supply and cut it down by means of a rheostat in series. For UV-199's we have four volts or 4½ which we cut down to three and in the case of a UV-200 and 201A we have an initial voltage of six which we cut down to five. But the trouble is, we very often do not cut it down to the proper voltage but allow our eyes to tell us how bright the tube should light up.

Unless you have had some experience in this manner of telling the correct voltage we do not recommend it. The hard tubes now on the market today are discolored to such an extent that one is barely able to tell whether the tube is lit or not and at best, it is not a safe method. With a D. C. filament volt meter reading from 0 to 5 or 0 to 7 volts you will be better able to regulate your tubes and their proper voltages and at the same time secure much better results and lengthen the lives of the tubes. Over-loading the filament of a vacuum tube decreases its life alarmingly. On one type of tube in particular an increase of 3 per cent over the rated filament voltage cuts the life of the tube one-half. A 3 per cent decrease below the rated filament voltage will more than double the life of the tube. So you see it is quite worth the initial outlay of $7 or $8 for a good reliable filament volt meter to know exactly what voltage you are putting on your tubes.

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Performance plus *Beauty*

Choose your panel for its insulating value as well as for its appearance.

MAHOGANITE
Radion Panels

give you both the supreme insulation and the beauty of polished mahogany. For Mahoganite is not a surface finish but a material which extends from one side of the Radion Panel to the other.

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6x14	7x21	10x12
6x21	7x24	12x14
7x 9	7x26	12x21
7x10	7x30	14x18
7x12	7x48	20x24

Look for this stamp on every genuine *Radion* Panel. Beware of substitutes and imitations.

RADION

The Supreme Insulation

PANELS

Dials, Sockets, Knobs and Insulators:
At All Good Radio Shops or write to

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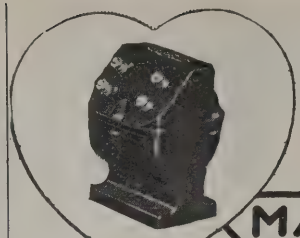
11 Mercer Street New York



Type A9 Shelltype
Ratio 5 to 1
$6.00
Audio F

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Your dealer will tell you why Marle Transformers do not howl or distort. Uniform amplification up to as many as 3,500 cycles.

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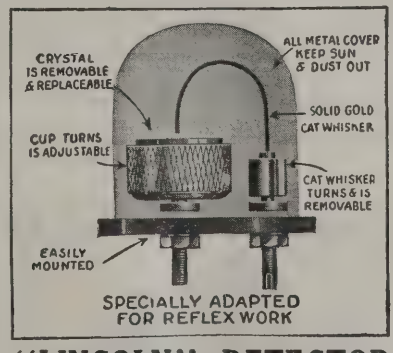
"Kills Reflex Troubles"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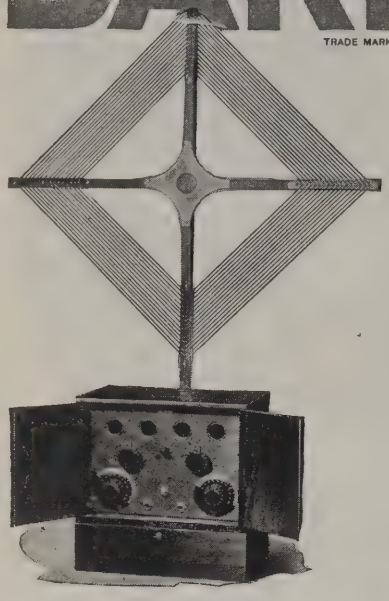

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Bakelite is standard insulation on all DeForest Radiophones — from panels to transformer covers. The effective protection afforded by Bakelite is a strong factor in the success of these well known radio sets.

Good insulation must have mechanical strength and rigidity, chemical inertness, heat and water as well as electrical resistance and, last but not least, durability. Bakelite possesses all these characteristics in a very high degree.

The fact that practically every radio manufacturer uses Bakelite is an excellent endorsement of its value for radio insulation.

Send for our Radio Map

Enclose 10c and let us send you the Bakelite Radio Map. It lists the call letters, wave length and location of every broadcasting station in the world. Address Map Department.

Write for a copy of our Radio Booklet A

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GAROD

NEUTRODYNE*

TYPE RAF $135 without equipment

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Made by
THE GAROD CORP.
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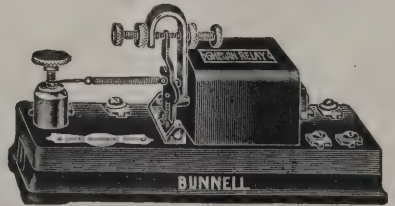
NEWARK, N. J.

GHEGAN RADIO RELAY



Taps permit tubes of various impedances to be used. With Bunnell Register this Relay will copy telegraphic signals at a speed of 60 to 90 words per minute. With Siphon Recorder speeds up to 200 words per minute have been obtained. Normal operating current is ½ to 2 milliamperes. Send stamp for catalogue No. 45 W.

Ghegan Radio Relay.....$40.00
Special Price to Dealers
J. H. BUNNELL & CO. 32 Park Place, New York City

Radio Frequency Circuits

(*Continued from page* 64)

ohms resistance is very imperative in most radio frequency circuits, and should by all means be used. The potentiometer is greatly needed to keep the set out of oscillation.

Adding Radio-Frequency to Regenerative Sets

The diagram in figure 2 shows another experiment made in adding radio-frequency ahead of a twin variometer regenerative set of standard type. The aerial was coupled through a variable condenser and tuning coil or primary of a coupler, as shown, and this circuit fed into the input of the radio-frequency set. The transformer lead to the plate terminal on the third radio-frequency stage was opened and a wire secured to the socket plate terminal, and this then led to a variable condenser shunted across the primary of the vario-coupler in the twin variometer regenerative set. It is advisable to also have a variable condenser of the 23 or 43-plate type (an 11 or 23-plate is usually found sufficient, unless the rotor of the vario-coupler has but a few turns of heavy wire on it) connected across the secondary to give sharper tuning. This circuit works all right with one or two stages of radio-frequency in use, but as will be apparent, one of the main objections to it is that there are too many controls. One advantage which might be imagined for this circuit would be that along with the use of the radio-frequency, there would be a gain of strength in signals, due to the regenerative action caused by the use of the variometers, etc., but as pointed out by several radio engineers and as actual experience has proven, there is a suitable regenerative action, or the equivalent of it, through the use of several stages of transformer coupled radio-frequency, and this is found to be equivalent or nearly so to the effects produced by using a regenerative detector circuit, as shown in figure 2. One more thing to be mentioned in connection with figure 2 is that if a variable condenser B is used across the secondary of the vario-coupler, the grid variometer may then be omitted.

In figure 3 is shown one method of connecting one stage of radio-frequency to a standard regenerative set. A 23 or 43-plate condenser may be connected across the aerial or ground posts and primary of the vario-coupler in the set as shown, but some radio experimenters have found this to be unnecessary, much depending upon the general design of the regenerative set employed. The writer prefers the use of a variable condenser across the primary of the vario-coupler; in any case

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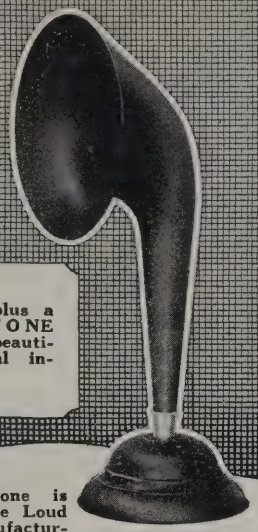

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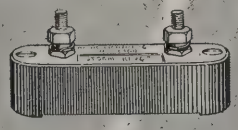

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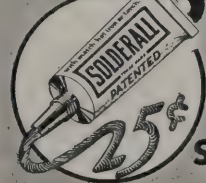

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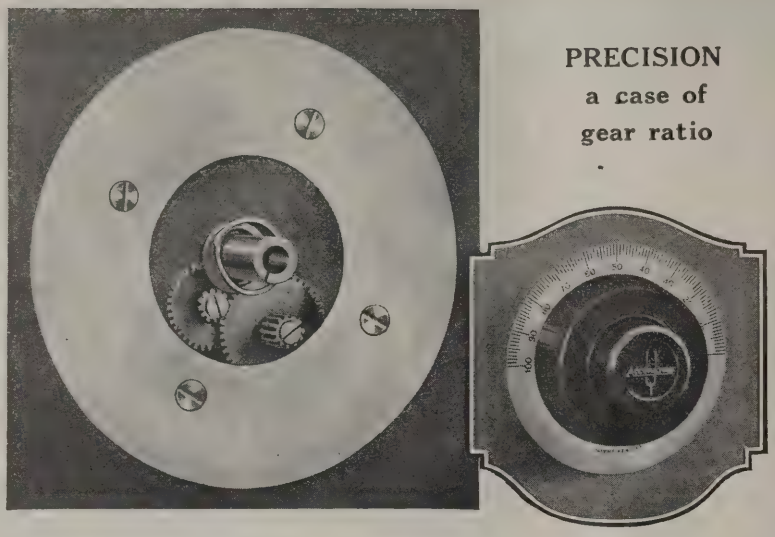

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it gives greater selectivity and much sharper tuning in every respect. The aerial tuning inductance may be either a tuning coil, a honeycomb coil of fifty to seventy-five turns, or a tapped inductance such as the primary of an old coupler, or else a coil wound with about seventy-five turns of No. 22 insulated magnet wire with switch taps taken off about every ten turns.

Amplifiers

(*Continued from page* 61)

times as great as the tube resistance, then it will be more than that at all other frequencies above it. But from our chart in figure 3 we see that when this is the case we obtain full amplification at all frequencies above 50 cycles and thus have no distortion. Thus the trick is to make the inductance L in figure 2 very great. A good value for L when used with such standard tubes as UV-201A or UV-199, is about 50 henries or over. Now this is a very large inductance and not easily built. It requires a great many turns on an iron core. For this purpose it is therefore suggested that the secondary of an audio frequency transformer be used for this purpose as it has the necessary inductance.

Such an amplifier, when it has choke coils of the high values given above, will give as good quality of speech and music as a resistance coupled amplifier. It is free from distortion. It has the added advantage that it requires less plate battery voltage, since the resistance of the choke coil is much less than the resistances used in resistance coupled amplifiers.

Radio Frequency

A radio frequency inductance coupled amplifier is a much more difficult proposition. The reason for this is that the inductance has distributed capacity, and this distributed capacity will by-pass the radio frequency. That is, the radio frequency currents will rather flow through the distributed capacity than through the inductance, and hence amplification will be sacrificed. Another difficulty is that multistage radio frequency inductance coupled amplifiers are unstable; that is, they have a tendency to oscillate, which results in poor quality speech and music and also decreased amplification. This type of radio frequency amplifier is to be avoided, for it becomes very difficult to handle, and one does not want to be under the necessity of continually having to be on watch and adjusting controls, especially when listening to concerts or speeches. This is not recommended therefore and will not be discussed.

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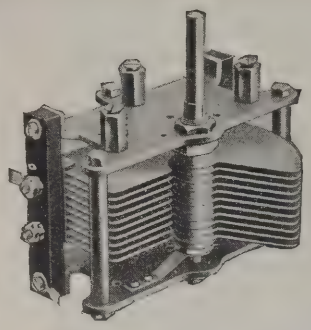

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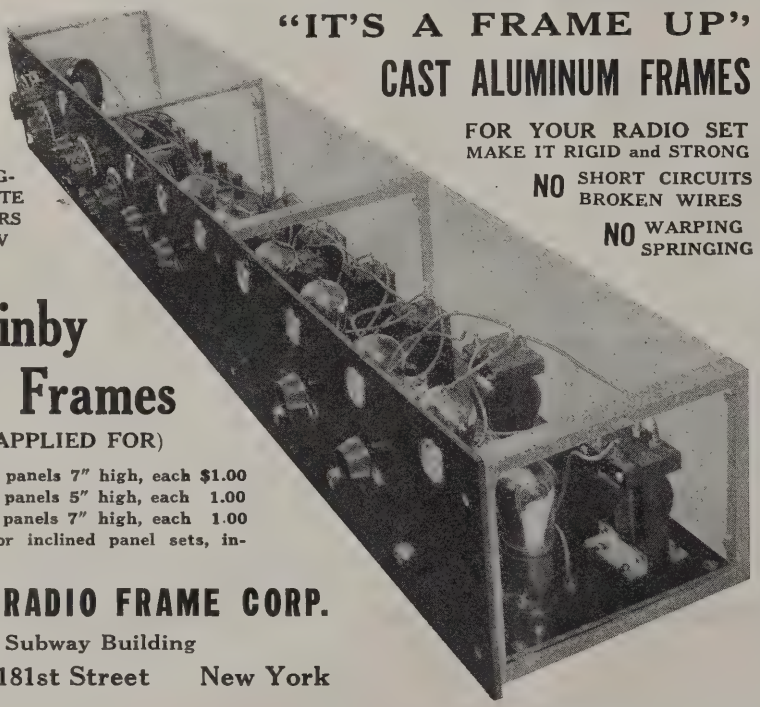

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Afloat and Ashore With the Operator

(*Continued from page* 53)

A recent issue of "Shipping Register," published in San Francisco, contained an interesting article about Arthur A. Isbell, now manager of the Pacific division of the Radio Corporation, and Lawrence A. Malarin, now district sales manager, in bridging the gap between Hawaii and the mainland of the United States when Mr. Isbell sent and Mr. Malarin received the first wireless message transmitted between those two points, in the year 1908.

The article also gives Mr. Isbell the credit of publishing the first wireless newspaper on the Pacific. This was in 1907 while he was operator on the *President*, since renamed the *Dorothy Alexander*.

Hundreds of messages now pass daily between San Francisco and Hawaii with less thought and trouble than that one eventful communication back in 1908.

High Lights in Radio Development

(*Continued form page* 71)

an instrument capable of this indicates the supreme care necessary in manufacture.

To eliminate entirely the human equation in matching the tone of the receivers, the Brandes company has installed a battery of ingenious supersensitive instruments to do this. These are so arranged that the receivers are tested both for volume and sensitivity, a needle on the dial giving the readings, and in addition indicates any grounds that may be present. The receiver is made to produce a note the same as that produced by a receiving set, and this note is picked up and recorded visually by a needle over the dial. The readings must be within certain limits, and those receivers showing the same characteristics are put in a box with others which registered similarly, later to be placed in pairs in headsets.

The illustration shows C. E. Brigham, chief research engineer of the Brandes Company, using the visual test machine.

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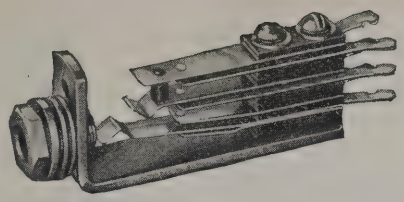
Nothing was heard from him all



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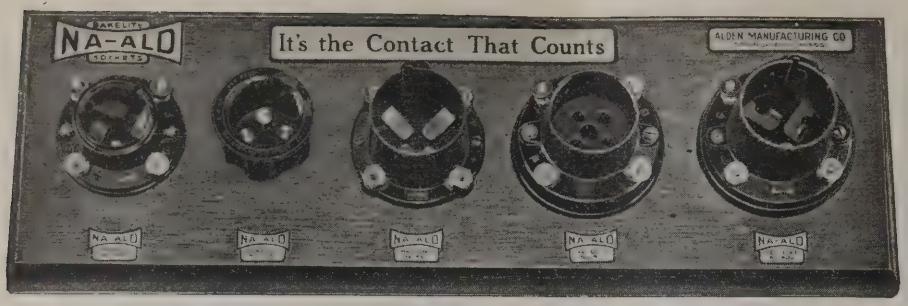

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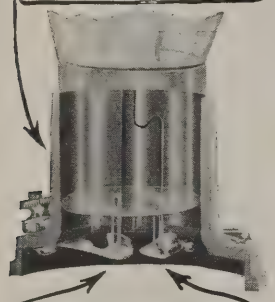

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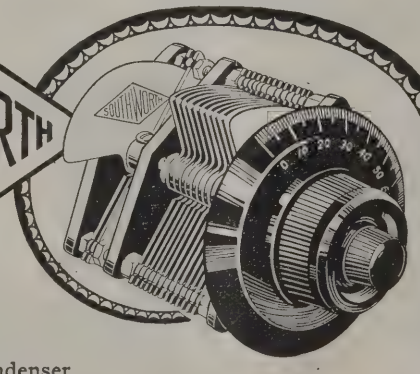

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during the cold, still, winter months, but when the warmer weather loosened up the ways and he again journeyed to the post with his furs, he immediately looked up the man from whom he purchased his radio outfit. The Frenchman was jubilant! He told of his little log cabin on the hill above the lake; how he would hurry from his toil among his traps to the now cheery little home where, during the long, dark evenings, he and his wife (for he was married now), could listen to beautiful concerts broadcast from Montreal, and to news from the outside world.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of the Wireless Age, published monthly at New York, N. Y., for April 1, 1924.

State of New York } ss.
County of New York }

Before me, a notary public, in and for the State and county aforesaid, personally appeared H. H. Reber, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Wireless Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Wireless Press, Inc., 326 Broadway, New York, N. Y.

Editor, Jerome W. Howe, 326 Broadway, New York, N. Y.

Managing Editor, None.

Business Manager, H. H. Reber, 326 Broadway, New York, N. Y.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent. or more of the total amount of stock should be given.)

Wireless Press, Inc., 326 Broadway, New York, N. Y.

Radio Corporation of America (owning all the stock of Wireless Press, Inc.), 233 Broadway, New York, N. Y.

The names and addresses of stockholders of Radio Corporation of America owning or holding 1 per cent. or more of the total amount of its stock are as follows: Cameron Blaikie & Co., 44 Broad St., N. Y. C., General Electric Co., 120 Broadway, N. Y. C., International Radio Tel. & Tel. Co., 165 Broadway, N. Y. C., United Fruit Co., 131 State St., Boston Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is.....
(This information is required from daily publications only.)

H. H. REBER,
Business Manager.

Sworn to and subscribed before me this 20th day of March, 1924. M. H. PAYNE.
[Seal.] Notary Public.
(My commission expires March 30th, 1924.)

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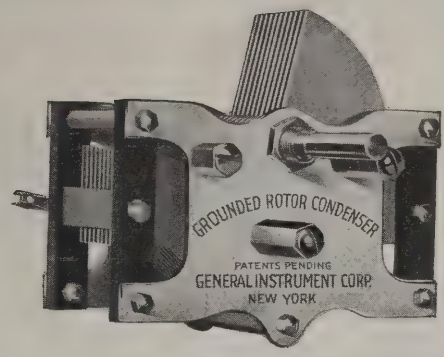
SEE PAGE 54



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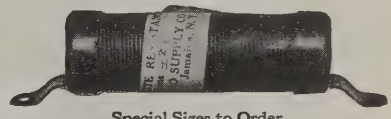

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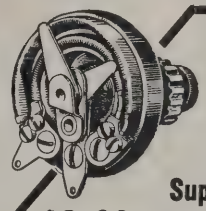

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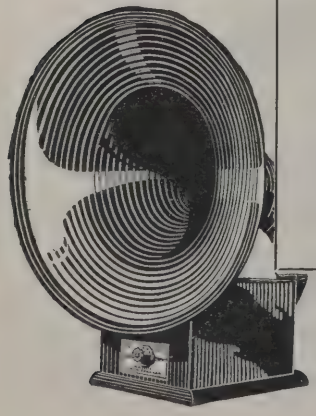

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VOLUME 11

THE WIRELESS AGE

"America's Foremost Radiophone Review"

NUMBER 10

Radio Plays the Game

THREE hundred thousand years ago, Man played the game in the weird, primeval forests. That was an epoch of thrillers now buried in the dim shadows of antiquity.

The lonely figure of an ape-like man doing a mile and a quarter steeplechase with a disgruntled bear might well be a legend on a race course today. A fifteen-round bout with a saber tooth tiger was a prize-fight of the championship class. Nine innings with the Neanderthal home team was a game worthy a page in the annals of history.

As civilization progressed, the race and the bout and the ball game emerged from the mire of prehistoric reality to the stadium where thousands gathered to witness the re-enactment as sport events.

The new epoch has come with radio. The volume of spectators has immeasurably increased with the advent of broadcast sports.

Race memory finds expression in our modern minds as we listen in on the races, the championship fights, and baseball.

* * * * *

THE grand stand is packed. An array of color; bright summer dresses, broad brimmed straw hats with pink ribbons gayly fluttering over feminine shoulders; neat suits of Palm Beach male attire, salt and pepper "sports," perhaps a cane, a field-glass case dangling at the end of a shoulder strap, Panama hats and straw sailors; below, restless figures lean on the fence, some whisper to brisk individuals who carry open satchels and forever copy things on pads, or perhaps, groups of threes and fours gather together with a chance "tip from the stables" overheard; all seem holiday-bent; for the race track is the Mecca of steeplechase lovers.

A murmur that spreads over the throng swells with the volume of ejaculation. The horses have been led on to the track. Brilliant, silk-clothed jockeys glance over their thoroughbreds. The horses seem to know, to respond, and lift their hoofs rakishly over the turf.

The mount! The gong! They're off!

We switch in the power amplifier—we hear the crowds yelling—we stick our heads into the loud speaker—the announcer shouts—Spark Plug wins!

OR is it evening, and the neighbors have joined us on the front porch? The big fight is scheduled.

We listen in to the even cadence of the announcer's voice, stationed at the ringside. A bit of patronizing comment on the preliminaries, and a word of sympathy for the suffocating crowd sweltering under the auditorium roof. We listen and chat, pretending to back our judgment if one is so bold as to contest it. Our banter is punctuated with the buzzing and thumping of a bottle-fly against the screen.

Time for the big fight. The announcer's voice becomes tense, vibrant as he describes the champions; their walk, their robes, their expressions. We crowd nearer the radio. The high-pitched, ringing voice of the fight-announcer slowly, tantalizingly introduces the big champs. A pause. The broadcast announcer tells us they are shaking hands—the gong—Dempsey leads with a right—another right—Wills returns with a left—Wills in the corner! . . . Second round—third round—Dempsey looks tired—backed to the ropes—down! He is up—a left—another left—a right! Wills down! . . . OUT! The count—he is OUT!

What's this? Grandma standing on her chair? Mother, head perked forward, wide-eyed, listening for more?

That is radio, dear souls. Sports are broadcast.

* * * * *

UNDER the mid-summer's sun are seventy thousand baseball fans; coats over arms, bald heads glistening here and there, handkerchiefs tucked into collars. White coated boys with baskets pick their way through the crowd. "ALL kinds of sand-wit-cheese! ICE-cold pop!"

Spontaneous cheering greets the team as it straggles out over the diamond. Shouts proclaim a newly discovered hero. Tiny figures scurry out to the fields. Players weigh and swing their bats. Some practice a few throws.

At our radio we hear the tumultuous clamor of care-free souls pledged to one afternoon of hilarious abandonment. It is infectious. One allure of baseball is the foregathering of our fellow beings to yell and shout and stamp until the innermost recesses of our systems have been purged of the dregs of inhibition and the residue of daily restraint.

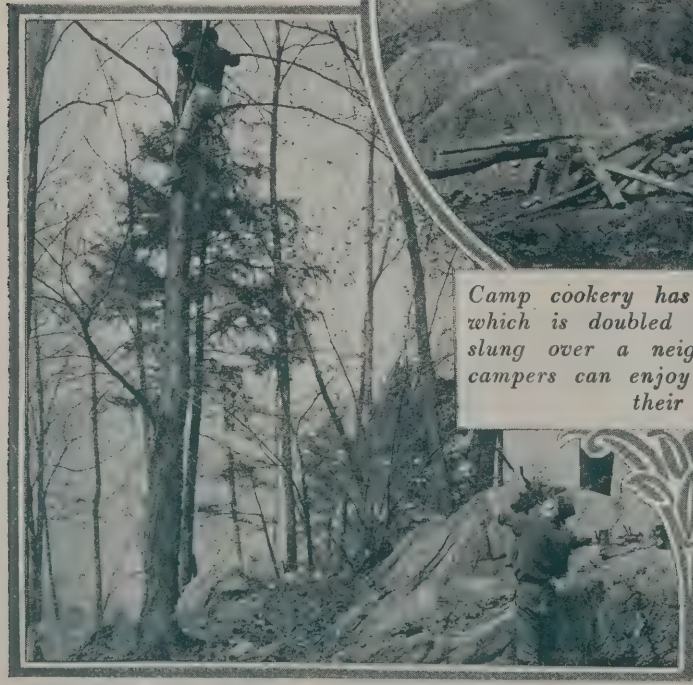
The ninth inning—the Babe at the bat—the score in the balance! Pandemonium reigns. Great waves of intonation sweep across the grandstand and break over the bleachers in a blast of triumph. The rhythmic cadence of a baseball game comes to us—grips us—becomes alive for us—in our radio.

Take Your Radio Out-of-Doors

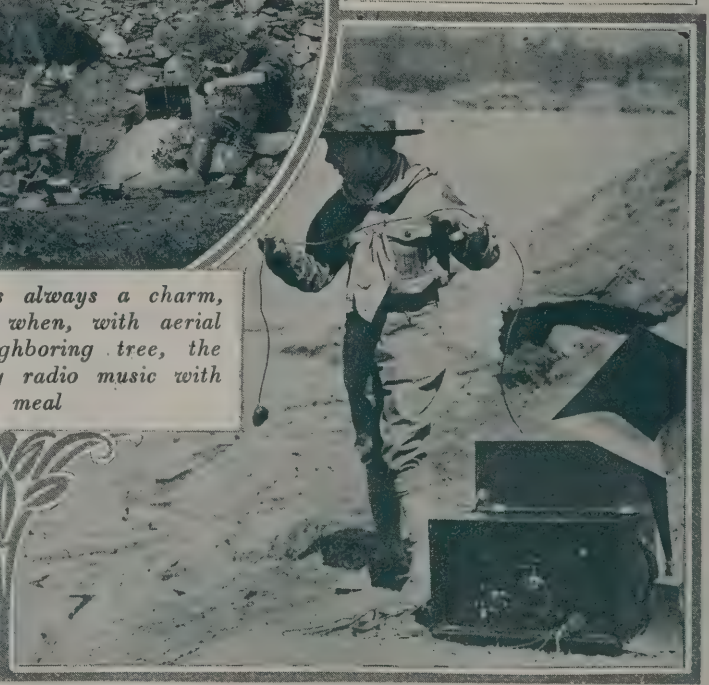
This World War veteran at Walter Reed Hospital cannot get out-of-doors, but his radio will bring the out-of-doors to him, as described on page 53

What better adjunct to a canoe trip than a radio receiver? Upon landing, hold a radio dance on the shore, like these happy voyagers

Camp cookery has always a charm, which is doubled when, with aerial slung over a neighboring tree, the campers can enjoy radio music with their meal



You can get plenty of height for your aerial while on a camping trip. Your agility and ingenuity will have full scope, and if your receiver is a good one, you will be amply rewarded



If your camp or picnic is by the water you can get an excellent ground by following the example of this Boy Scout who makes a few turns of the ground wire around a stone and casts it into the water

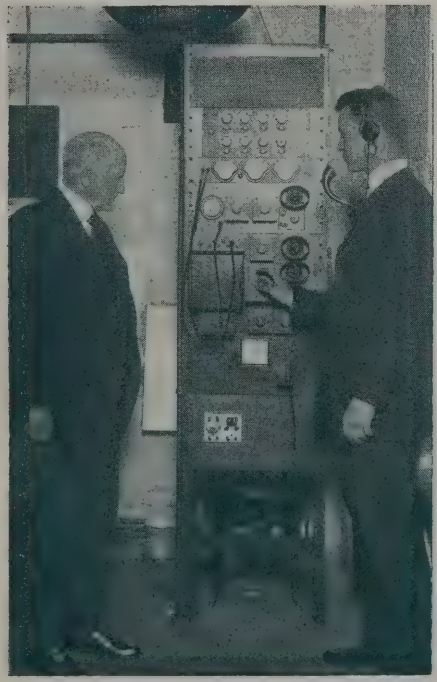
THE Honorable Royal S. Copeland, U.S. Senator for the State of New York, is a man of broad activities and wide interests which makes his statements made to readers of The Wireless Age on the subject of politics and radio of great significance. Senator Copeland is a member of the medical profession which he has graced with many accomplishmnts. After completing his medical studies in England, Germany, Belgium, France and Switzerland, he returned to his native State of Michigan where he practiced his profession, later joining the medical faculty of the University of Michigan. In 1918 he became Commissioner of Public Health and President of the Board of Health of New York City, which position he vacated upon his election to the United States Senate. He has been Mayor of Ann Arbor, Michigan, and President of the Board of Education; this in addition to numerous exceptional activities and writing in connection with his profession of medicine. Newly involved in national politics, it is natural that Senator Copeland should be much interested in the political aspects of radio broadcasting.

Senator Royal S. Copeland and his son, Royal, Jr.

Senator Royal S. Copeland

Writing expressly for The Wireless Age, says:

Radio Will Improve Politics



Speaker Gillette (left) of the House of Representatives. Mr. A. Bodwell (right), operator in charge of the broadcasting system installed at the Capitol awaiting the bill authorizing broadcasting of all speeches on the floor of the House

WE are living in a remarkable age. No one dares say today that the thing always counted as impossible cannot be done.

I have read the accounts of many political conventions and campaigns. I venture to say that the approaching conventions and campaigns will differ from all preceding ones.

Space has been annihilated. Even the blind can know what is going on in politics. Through the boundless ether the proceedings of the conventions will be broadcast. To every household, no matter how remote, will be carried the voice and words of the candidates for high offices.

There can be no doubt that we learn much more of the character through the spoken word than through the written page. The honesty and sincerity of the speaker can be measured by his voice and the manner of his presentation of the speech. "Out of the fullness of the heart the mouth speaketh." It is impossible to hide the impulses of the heart in the expressions of the voice.

The arch hypocrite can sit down in his closet and pen words which have all the semblance of the truth. They may be untruthful statements of the real motives of the man who writes them.

I rejoice in the invention of the radio because it will give to every citizen, no matter where he is, an intimate knowledge of men and events. The next six months will reveal to the millions of our country the worthiness or unworthiness of candidates for high offices. With greater intelligence than ever before the electorate will march to the polls next November and determine the fate of the country during the next four years.

ROYAL S. COPELAND.

A Baseball

How the Opening Game of Into a Game of Strategy. The and How *The Post* Made a

A Story by

THIS was Red Letter day for *The Post*. Broadcast receiving equipment had been installed for the world series. The opening game would soon be on the air.

A score-board, mounted on the front of the building, is laid out in the form of a diamond, provided with blank squares in order that the name of each player can be inserted in the space that will indicate his position during the play. A loud speaker, above, will provide the broadcast announcer's description of the game.

The crowd, gathering in front of *The Post,* has already swelled to mob-like proportions. The north-bound trolley, with a great amount of bell-clanging, forces its way through the surging mass. Automobiles, angrily protesting with blatant horns, turn down side-streets in last paroxysms of despair. Mass-confidence becomes evident in the occasional cheering that spreads through the jostling crowd. Blue-coated reserves circulate through the jam, striving to break the unity that becomes more apparent as the baseball fans respond to the infectious mob-spirit and press forward.

A tousled-haired street-urchin climbed up on a water-plug, his bare toes clinging to the spouts, and one dirty hand gripping an unfortunate bystander. With his cap waving in his free hand, he yelled, "Come on wid d'game! Wud d'you think we're here. . . . "

His spirited rooting was cut short by the man he had grabbed. The injured party jerked the bewildered waif from his point of vantage. "And what do you think I'm here for?" he demanded.

The little Arab wriggled from captivity and lost himself in a forest of legs.

* * *

THE editorial office was a scene of tense, feverish excitement. The city editor glances over each sheet that is passed to him by the proofreaders. Without looking up he calls *copy* and then passes on to the next. The office boy slips the copy into a cartridge, injects it into the tube for the type room, and dashes off on another errand. The managing editor rapidly scans the columns of contemporary newspapers. It is inconceivable that he can read the news so quickly. He clips, marks, and passes the items to feature writers. Reporters rush in, hammer at typewriters, rip the sheets from the machines, toss them on to the copy desk and rush out again for more news. No one is aware of another's presence. Intent concentration is broken occasionally, only to settle again, as the spasmodic eruption of one job done has passed to another, and yet another, in the frenzied haste to get the first edition on the press.

To the uninitiated, chaos would seem to be paramount. Actually, the editorial staff worked with machine-like precision. The linotypers and compositors were fast and efficient. The web pressmen stood by the giant presses, alert. Trucks, backed against the curb, engines throttled low, waited for the first bundles of newspapers. The editorial office, like the mainspring wheel of a watch, has started. All through the mechanism, cogs slip into cogs. The minute-hand will soon be ticking off the seconds of news that will grow stale with the dissipation of exhaust-gas from the fleeting delivery trucks.

* * *

HERBERT KNOWLES, the managing editor, has the sharp features indicative of a nervous, driving energy. His sparse, iron-gray hair is brushed back in pompadour fashion from a high forehead. One imagines, at first glance, that Herbert Knowles is less of executive timber, than of artistic temperament. The vague suggestion of drawn lines at the corners of his mouth, however, contradicts one's first impression.

Knowles stepped over to the city desk. "How about it, Gaston?" he inquired.

The one addressed is the city editor. "All set," he replied.

Harry Gaston, as city editor, had never failed to support Knowles with the practical initiative essential to the success of each new project instigated by the latter. Knowles's query was, in effect, nothing more than a gesture of impatience. He meant to imply that if the first edition was ready, it would be well to get it on the press and out of the way for the afternoon's broadcast reception. Gaston's reply was cryptic. It indicated that he was master of the situation, and that the stage, having been set, only awaited the proper signal. The cue had been given.

The presses roared. It is a sensation less of hearing than of feeling. The "beat" note injects new enthusiasm into the workers — stimulates them to greater effort.

PRIZE WINNER

in the "Radio in the Home Picture Contest." Receiver and loud speaker combined in a home-made cabinet that harmonizes well with the furnishings

Won by
Thomas J. Neece,
Colorado Springs,
Colo.

Scoop by Radio

the World Series Developed Unexpected Turn of Events, Scoop on the Final Score

William A. Hurd

TIME for the game. A man stepped out onto the platform in front of the score-board. A voice from the loud speaker announces the players. A voice from the grandstand, a thousand miles away! Batter up! The game starts!

A thousand voices rise from the street in a yell that reverberates long after the noise of the grandstand and bleachers has subsided in the loud speaker.

Type is set as fast as the broadcast announcements come over the air. Not one moment, even for display type, can be lost in getting out the final baseball edition. Seven column heads, in giant type, are prepared; one for each possible result. Every member of *The Post's* organization is keyed to a high-strung passion of expectancy. Each new edition off the press increases the tension.

Outside, the continuous cheering breaks into a shouting, that breaks again, and sweeps through the crowd in great waves of tumultuous yelling and whistling. A left-handed batter has been put in against a left-handed pitcher. A right-handed pitcher has been substituted. A right-handed batter has been brought up in retaliation. A left-handed pitcher is again put in. Batters are changed. The game becomes a contest of strategy. Head work must win against brawn. The broadcast announcer follows the game with a photographic image of each play registered in his mind. He translates the visual picture in remarkably self-controlled, dispassionate phrases, transcribing the clear, verbal picture with vivid exactness. Listeners "see" the game a fraction of a second after it has been witnessed in the grandstand and bleachers.

Bases full in the ninth inning. A slugger at the bat. A resounding crack announces the hit before the broadcast announcer can locate the ball, soaring into the sky. It's dropping into the left field. The outfielder slips in the mud of the morning's shower, regains his footing, and reaches for the ball. He's got it!

While the milling crowd in front of *The Post* was still trying to outyell the voices in the loud speaker, the final baseball edition was rushed from the presses to the waiting trucks, and hurried off to the news stands. The editors gathered at the windows to watch the throngs below. Newsboys were selling *The Post* as fast as they could be distributed to fans who had just heard the score direct from the scene of action, and who, just this moment past, witnessed the score in white chalk on the board, which is still to be seen if one cares to look. But, no! These are baseball fans. They want more news, more of the same news. They must go over the details again, recalling each thrilling incident.

The crowd gradually dispersed. Spaces widened as the impatient traffic pressed its advantage. The loud speaker suddenly made a startling announcement. The rapidly thinning crowd paused, then gathered again. Knowles, at his post in the window, turned to stare, questioningly, into the eyes of Gaston who had also turned, his gaze fixed. Both grasped the import of the situation at the same instant. The broadcast announcer had just given a reverse decision on the game!

The outfielder had missed the ball. It had struck the mud, and sunk. In a flash he had seen that it had escaped the notice of the players—had not been detected from the grandstand. He had slipped his hand into his pocket, as though to deposit the ball, and nonchalantly removed his glove as he strolled over to the benches. In the midst of the wild pandemonium that immediately followed his catch, there was small likelihood that his ruse would be discovered.

A few, on the extreme end of the left bleacher, had seen—or believed they had seen—the ball slip to the ground. They were followers of the losing team. Doubt warranted an investigation.

Point by point, the investigation was broadcast. A baseball crowd is not to be quieted so easily in the face of a sensational fraud. Voices rising above the tumult could be heard: "Kill the umpire! Call the game off!" Such exclamations were irrelevant, but excitement had reached the fever heat that demands somebody's "scalp," be he ever so far removed from blame.

* * *

The presses roared — throbbed — ejected the EXTRA. The printed copy from the frantic editorial office appeared on the streets with blaring headlines: RADIO EXTRA * * * REVERSE DECISION ON GAME!

Radio that day had given *The Post* a sensational beat. The baseball fans had acquired season tickets to the World Series.

PRIZE WINNER in the "Radio in the Home Picture Contest." George M. Maxwell of Duluth, Minn., wins a prize with this photo of his four-tube reflex appropriately installed in a library table. The batteries are contained in the drawer

King Radio

An Extravaganza in One Act

By Adam Hull Shirk

SCENE

The Magnetic Field of King Radio's Domain. A vast plain with great coils rising in the background.

TIME

The Present

CHARACTERS

King Radio, a modern monarch.
Atuba, his beautiful daughter, the Princess.
Prince Aerial, her lover.
Clicks, a despicable fellow, also in love with Atuba.
Blooper, his henchman.
Grid Leak, a buffoon.
(Chorus of Electrons, Condensers, Battery A, Battery B, etc.)

OPENING CHORUS

Electrons—Beautiful maidens, the Princess' favorites all attired in flimsy blue garb.

'Twixt grid and plate, it is ever our fate
To be buffeted to and fro—

We dance with glee, then we cease to be,
When dims Atuba's glow.
When the filament flames, we play joyous games,
And ne'er from our homes we stray.
We're electrons—so small—but we do it all—
With never a cent for pay.

(Enter Clicks and Blooper—The Electrons draw back in fear.)

CLICKS—Aha—the fair Electrons are out.

BLOOPER (Squealing)—Whee-oo, whee-oo.

CLICKS—Good boy, you make music after mine own heart.

BLOOPER—Nobody loves me.

CLICKS—Hist—aid me and thou shalt have a million electrons for thy very own.

BLOOPER—Squeals with delight.

CLICKS—Listen, Blooper—I love Atuba, but she will have none of me. To win her I have a plan. You shall aid me. We will kidnap her electrons and hide them. If she will not accept my suit I shall destroy them.

BLOOPER—But you promised me—

CLICKS—Aye—but if I give them to thee, they are destroyed. Now I know several members of Battery B. They are all low fellows. Why they have lost many volts since last night—soon they will be dead unless I can aid them. Go, summon the B Battery and we will capture these electrons on the Magnetic Field—go!

(Exeunt Blooper while Clicks approaches the huddled group of Electrons with a low bow.)

CLICKS—Ladies, thou art extremely beautiful. I fain would entertain you with a song.

FIRST ELECTRON—We like not thy voice, and it please you, sir, you are so rough and our sweet music is spoiled whene'er thou singest.

CLICKS—Ah, but my latest song is wonderful—hearken to my dulcet tones—(Song by Clicks)—

I LOVE TO SPOIL A PRETTY TUNE

When the Listeners-in are listening
To a far off DX call,
I love to rattle off a song
And hear the ear-phones fall!
I bring a crash like thunder,
While the fans sit lost in wonder;
And I split their ears asunder
As these words I loudly bawl—

CHORUS

I love to spoil a pretty tune.
I do it morning, night and noon.

I'm hated by the BCL's and all Broadcasters, too.

While the violin is wailing and the 'cellos softly moan,

I set my cracked voice sailing and I hear the listeners groan—

Yes, I'm Clicks, so erratic,

But my voice is most emphatic

When I spoil some soft, alluring little tune.

(Enter Battery B, a lot of rough looking chaps, with Blooper at their head. They all rush toward the terrified Electrons and quickly take them prisoners. All exit.)

(Enter Grid-Leak, a bullet headed fellow in a yellow suit.)

GRID—I thought surely I heard voices—perhaps some of the sweet Electrons are about. Oh, how I love 'em. If only I weren't married to Condenser—as it is I'm fixed for life.

(Enter Prince Aerial, a tall, handsome young man, with a couple of insulators on his head and a long pole or staff in his hand, to which is attached a lead-in of bright copper.)

GRID—(Falls on one knee)—Oh, kind master, illustrious Prince Aerial, I think there are electric strays in our magnetic field; in other words something is interfering with reception.

AERIAL—What reception?

GRID—(Getting up)—The lovely Princess Atuba had planned a reception for you, but I fear me it will never be held.

AERIAL—What mean you?

GRID—That villain, Clicks, is planning mischief—I heard his voice anon. He too loves the Princess.

AERIAL—I will slay him.

GRID—Hist!—he comes. Hide, sir, here.

(They draw aside behind a coil and enter Clicks alone.)

CLICKS—(Rubs his hands)—Now I have the Princess in the hollow of my hand. I have her maidens closely mewed up—and ere nightfall, and the DX stations are on the air, I will have destroyed her power and she will be disgraced—then she shall sue me for mercy and even King Radio himself shall bow to the will of Clicks. Ah, someone approaches—I will hide.

(He hides behind another coil and enter King Radio with his courtiers—the Battery A's; a lot of mica condensers; Loud Speaker, his Minister—a noisy fellow; Spaghetti, the Court Cook; Bus Bar, who runs the saloons of the Kingdom; Transformer, an actor, etc.)

KING—So—the Magnetic Field seems deserted. 'Tis here I would fain conduct the mains 'twix gallant Knights. Is all in readiness for the jousts?

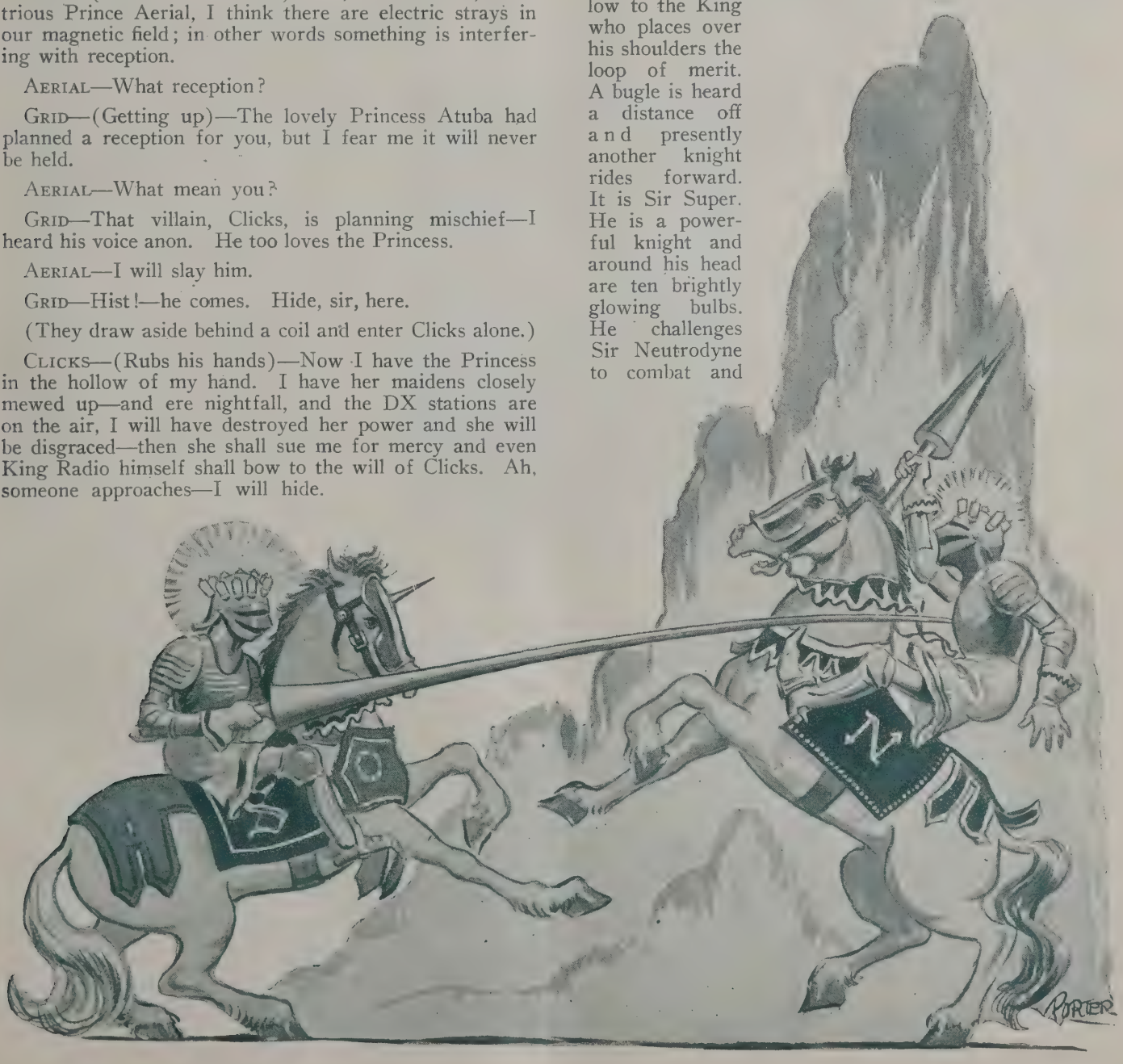
LOUD SPEAKER—Aye, sire, even now, the valiant Knights approach—see, there is Crystal, on the white charger and yonder approacheth the mighty Neutrodyne.

KING—I see, I see—and yet I hear there is one greater than Sir Neutrodyne.

TRANSFORMER—Pardon, your majesty, you mean—Sir Superheterodyne?

KING—Even so, but here come our knights.

(The two knights ride up and presently, at an order from the King, and a cry from Loud Speaker, canter to opposite points of the field and with lances thrust forward ride like the wind toward one another. Crystal is unseated and Neutrodyne rides up and dismounting, bows low to the King who places over his shoulders the loop of merit. A bugle is heard a distance off and presently another knight rides forward. It is Sir Super. He is a powerful knight and around his head are ten brightly glowing bulbs. He challenges Sir Neutrodyne to combat and



they take their places. After several tilts, Neutrodyne is badly hurt and Super is given the Loop of Merit).

(Prince Aerial emerges from his hiding place and approaches the King; the King greets him kindly and he faces Sir Superheterodyne.)

AERIAL—Sir, thou art a braggart and a knave. By foul play which I observed from my hiding place thou didst unseat poor Sir Neutrodyne, but for all thy loop of merit and ten tubes of brilliancy, I will outdistance thee—I challenge thee to a race.

SUPER—Bah—stripling—I will defeat thee—knowest not that I am the greatest in all the Kingdom of Radio?

(Song by Super)—

I TOP THEM ALL

You may talk of distance getters,
And of logs both great or small,
But in speaking to your betters
It is meet that you should fall
On your knees to worship rightly
One about whose head so brightly
Shine the tubes of vacuum nightly
Bringing distance to us all—
For I top them all—I'm the Super!
I fear not Clicks or Blooper!
Yes, I'm Superheterodyne;
Ever brightly will I shine;
Henceforth the world is mine—
For I am Super!

AERIAL—Bah—I can still outdistance thee—(He springs on the horse of the fallen Neutrodyne and races off, with Super in hot pursuit. As they disappear in a cloud of dust, enter Atuba weeping).

ATUBA—Oh, father, father—I am undone.

GRID (who has followed Atuba—anxiously)—where?

KING—My child—what's amiss?

GRID—An unmarried woman.

KING—Silence or I'll have you fixed.

GRID—I'm already fixed.

ATUBA—(wringing her fair hands)—My electrons.

ALL—Yes, yes—go on—

ATUBA—They are gone—vanished—I am helpless, alone, my light is out, my plate is empty, my filament is cold.

ALL—Ye gods! Her electrons are gone.

KING—But where—?

GRID—Pardon, sire, I think I know—I suspect that that varlet Clicks hath kidnaped them—he and Blooper.

KING—But why?

GRID—He seeks to get you and the fair Atuba in his power—he loves her and hates Aerial.

(Re-enter Aerial. He has outdistanced Super.)

AERIAL—It is as I said—an aerial is always best when distance is concerned. (Sees the excited crowd, and goes to Atuba and takes her in his arms). My darling, what is it? Lean on me.

(Song by Aerial)

LEAN ON ME

What ere betide, sweetheart,
Lean thou on me.
When by my side, dear one,
No ill thou'lt see.
I'll bring thy fair Electrons back to thee,
Dear heart.
Lean thou on me, lean thou on me.

ATUBA—Save my Electrons and my life and I am thine—my Prince.

AERIAL—I'll rout Clicks with the aid of my good friend Wave Trap and ere nightfalls thy Electrons will be safely home again. Farewell.

(Aerial again mounts the steed and gallops away and all others exeunt save Atuba who sits by the side of a huge coil and sings:)

(Song by Atuba)

I LOVE HIM SO

I love him so—my Aerial,
And now I'm sure, he knows it well.
If he should save my maidens fair,
My hand he'll win, my heart he'll share.

I love him so, my Prince of Air,
But oh, my love, if you do care—
Bring back my maidens all to me,
Or life a vacuum e'er will be.

(A great noise a distance off. In a moment, enter Aerial with Clicks as a prisoner, while Wave Trap, a square, solid chap, holds the squealing Blooper. From opposite side enter the King and others.)

AERIAL—(Turns Clicks over to Grid and comes to Atuba, whom he takes in his arms)—My darling, you are saved; thy electrons are rescued from the cruel hands of these miscreants of whom, I'm sure, thy father and Wave Trap will make short work.

GRID—I'll shake Clicks up a bit on my own account.

(Shakes Clicks, who growls and snorts, but is helpless at last.)

ATUBA—Where are my Electrons? I see them not.

AERIAL—Here they come.

(As he speaks the stage grows more brilliant than before and the maidens enter. With them is Neutrodyne with his head bandaged, but looking better. Super, at one side, shows his anger. Blooper squeals and Clicks curses and growls.)

ATUBA—I am so happy (embraced by the Electrons, she breaks away to take her father by one hand and Aerial by the other).

(Picture formed and the villains are led off to be punished.)

ENSEMBLE CHORUS

For we are the people of Radioland;
It's just around the corner from Fairyland.
Fans everywhere our happiness share;
There's pleasure for all and a lot more to spare;
So sing with us, laugh with us, joy with us—
Friends of the air—
And join us in Radioland!

(Curtain)

Scouts Who Have Made Good in Radio

Scout Lyman F. Barry made an early start in radio, and through persistent effort won the ten-year veteran's badge and a recognized proficiency as a radio man and scoutmaster

By Armstrong Perry

THERE are different kinds of radio "bugs." There are technical amateurs who love to pull their apparatus apart and assemble it in different ways, without ever waiting to understand or use what it brings in from the ether. There are amateur operators so selfish that they want the air all to themselves and complain because the growing interest in broadcasts forced the Government to keep amateur signals from interfering wi.h them during the evening hours. When technical ability is hooked up with the Scout spirit, then there is produced a radio amateur who makes his mark in the world, as is proved by the experience of the Scout whose story is briefly told below.

Scout Lyman F. Barry became interested in radio through his Scouting activities and received his early instruction from the chapter on "Tracks, Trailing and Signaling" in the "Handbook for Boys."

In 1917 he set up his first radio station, which consisted of a crystal detector receiving outfit. It did not remain in service long, for the United States entered the World War that year and the police called to inform the Scout that the use of radio by private citizens had been prohibited.

Barry engaged in such signaling practice as was permitted, and in October he secured the merit badge for signaling. It was not until 1920 that he was able to take the merit badge test in radio, but he secured the badge then and kept right on until he had twenty-six merit badges in all.

He was a charter member of the Manhattan Association of Radio Scouts, in New York City, and often operated their transmitter at headquarters. The station's call letters, 2BDS, have been heard by many amateurs. With other radio scouts he visited the headquarters of the District Communication Superintendent, Third Naval District, and received instruction in the methods by which the Navy covers the world with its communication system. He registered with the Radio Amateur Bureau conducted at these headquarters, as Amateur No. 345. Later he passed a code test at twenty words a minute and was advanced to Radio Amateur No. 2, being next to the Sea Scout Radio Commodore on the reserved list. He copied the amateur

Lyman F. Barry in his uniform of 2d Lieutenant of the Officers Reserve Corps of the United States Army

broadcasts transmitted daily for members of the bureau and sent copies to the Sea Scout Radio Commodore.

He entered the College of the City of New York and became a charter member of its radio club, operating the college's two experimental stations, 2XN and 2XNA on 200, 360 and 600 meters. He was elected secretary and afterward vice-president of the club, and was active in affiliating it with the Second District Executive Radio Council and the American Radio Relay League. He had been a league member and relay operator for several years.

Barry's first amateur station license was earned by passing the governmental examination in December, 1919, soon after war-time restrictions were removed from amateur transmitting stations. His call letters, 2OH, are still heard over a wide area. He began with a spark set and worked his way up through various types of transmitters until he was able to handle the four-tube continuous wave transmitter at City College without difficulty. He built most of his own apparatus and before he was through college had a triple honeycomb coil regenerative set with two stages of amplification.

In 1920 he went with the Reserve Officers' Training Corps to Camp Devens, Massachusetts. Colonel Holden, the commanding officer, placed him in charge of the radio station. Scout Daniel O'Connell was his assistant. They copied the weather forecasts and news from NAA, the Navy station at Arlington, and posted them for the benefit of the whole camp. Barry was then a lieutenant and O'Connell a sergeant. Both became captains in the R. O. T. C. and received commissions in the Officers' Reserve Corps of the Army. Both also became scoutmasters.

His military work did not keep Barry away from scouting. He went to the winter camp of the Manhattan Council in 1920, and his portable crystal detector set gave the camp its only news of the outside world, though the best he could do for the temporary installation was to put a thin wire aerial fifteen feet up in the air. As the nearest telephone was across the lake, Barry and his radio outfit were important additions to the camp.

When summer came, he took a vacuum tube receiver to Geneseo, New York, where he spent a vacation. He posted the weather forecasts and the news of the day so that the people in the village could have as up-to-date information as the city residents have. He received from NAA the first reports of the disaster to America's first great dirigible balloon, being only a short time behind the Sea Scout Radio Commodore who, in Washington,

(*Continued on page* 80)

FIRST PRIZE
won by G. W. Rose of Winfield, Kansas

The set is an eight-tube Super Heterodyne, everything self-contained in the cabinet but the loop antenna and the A battery. The set, and the inside cabinet were designed and built by Mr. Rose, the large cabinet being purchased at a furniture store. The entire cabinet work is of the Gothic period design and is of solid Mahogany in Tudor antique finish.

The panel is bordered by a mahogany frame. There are only four visible controls: "oscillator" dial to left, tuning dial to right, volume control or potentiometer upper center, and master filament switch lower center. All the other controls are contained within the two small doors to the right and left. All metal work such as dials, pointers, switches, etc., are gold plated. The dials are also hand engraved in Roman numerals. The horn for the loud speaker is acoustically designed.

Radio in the Home
Conclusion of Prize Contest

You must agree that this page is an appealing exhibit of the beauty of radio in the home. In the April number of "The Wireless Age" and again in May, readers were invited to compete for some valuable prizes by sending in photographs of their radio sets in home surroundings. The results have been more than gratifying and some of the entries are presented to readers of "The Wireless Age" in this number. The winner of the first prize, a fine Wireless Age Receiver, is G. W. Rose of Winfield, Kansas, whose beautiful photograph of a remarkable radio set is shown above. The second prize, $10.00, is awarded to Tompkins and Lyon of Chicago, whose entry, shown below, is worthy of emulation. The third prize, $5.00, was won by L. E. Saft, Jr., of Union Hill, N. J., with the remarkable artistic photograph shown at the left. Awards were made not alone upon the basis of beauty of photograph and furnishings, but in consideration of what contestants had managed by their own ingenuity and artistic sense to contrive in the way of cabinet, housing for batteries, disposition of wires, etc. On the opposite page and elsewhere through this number other prize-winners are shown, making altogether an interesting exposition of Radio in the Home.

SECOND PRIZE

shown at the right illustrates a 5-tube neutrodyne set designed by Tompkins and Lyon of Chicago.

The cabinet used is a dining room server large enough to accommodate the B batteries and a Timmons Talker. The storage A battery is installed in the basement along with the charger, being connected so that the battery may be charged by turning a switch.

The THIRD PRIZE was awarded to the beautiful photograph shown above, which is a 3-tube Reinartz set made by L. E. Saft, Jr., of Union Hill, N. J. A Timmons Talker is used with this set also, the A battery being placed behind it, and the B batteries installed in a specially made base that extends under the receiver and Talker. The whole set is placed in a serving table with doors.

Radio in the Home Prize Winners

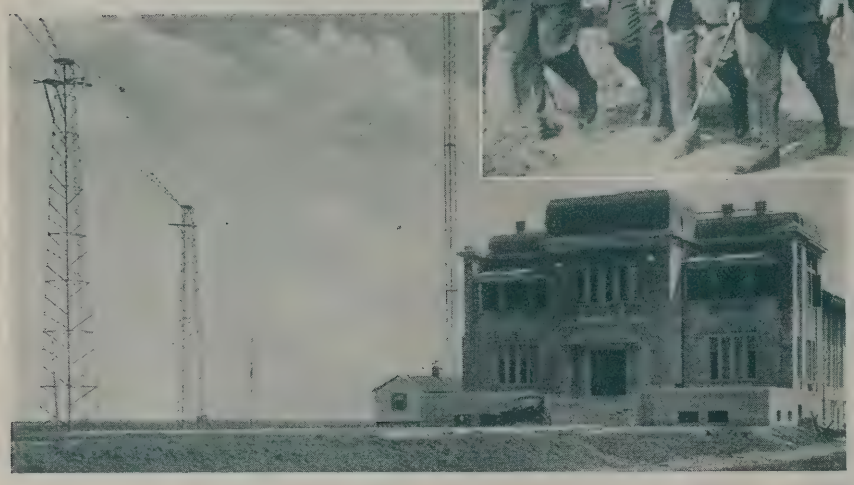
Austin H. Martin of Glen Ellyn, Ill., places home-made receiver in discarded desk with batteries in drawer, and uses Victrola for loud speaker

This radio installation submitted by Harry M. Dittman of Narberth, Pa., is an example of artistic arrangement

J. B. Michaels of Bristol, Conn., encloses his set in a case of Japanese driftwood; batteries and chargers too; phone connection block at right provides for six headsets. The panel and dials are of mahoganite

A library gives an excellent opportunity for a harmonious radio installation. This illustrates radio in the home of D. E. Prendergast of Brooklyn, N. Y.

The President of the Argentine Republic, M. Alvear, inspects the new high-power wireless station and is pleased with this great accomplishment of the engineers of the world's great radio companies



TRANSRADIO

ARGENTINA TO THE FORE

New Station reaches out to New York—5,500 miles and to Europe—7,000 miles

By Col. C. H. Nance

THE high-power radio situation in the Argentine Republic three years ago was little short of chaotic. The four large radio companies of the world, the Radio Corporation of America, Marconi's Wireless Telegraph Company, Ltd., the Compagnie Générale Française de Télégraphie sans Fil and Telefunken, each were interested in an Argentine concession for the establishment in the vicinity of Buenos Aires of a station capable of communicating with their respective countries. Had all of these stations been constructed and operated so closely together, the interference difficulties in an already overcrowded ether can be imagined. Commercially, the different companies were confronted with the staggering figures of the investment necessary to build such powerful stations, and the possible traffic flowing from Argentina made a suitable income from such capital appear doubtful. Then too, each company only possessed certain of the Argentine patents needed to insure good communication and completely modern equipment, while the others owned other equally valuable ones. The result of this unsatisfactory state of affairs was the formation of Transradio Internacional, an Argentine corporation with a capital of 14,000,000 pesos, which under a concession granted by the government in January, 1922, proceeded with the erection of a super-power radio transmitting station at Monte Grande, some thirteen miles south of Buenos Aires, and a receiving station at Villa Elisa, some twenty-five miles away, and distant about twenty-three miles from Buenos Aires. Each of the four companies named possessed a proportionate interest in the new concern, in which Argentine capital was also strongly represented, and the uniting of the various concessionaries assured to the country the use of the best patents and the combined technical skill of the best radio companies of the world, so that by the middle of January, 1924, another gap in the net of world-wide radio communication was closed.

The Argentine government and the public generally welcomed the advent

Here are the high frequency alternators that generate a 6,000-cycle current of 1,000 amperes with a voltage of 750. The control table, the transformers and the condensers are also shown here

Section of the Control Table

of this new service, because in addition to its thorough modernity, it assured the country an independent outlet for its external traffic, and the two outstanding traits of the Argentinian are his love for the latest and most modern of everything, and his patriotism.

President Marcelo T. de Alvear turned aside from his many executive duties and graciously accepted Transradio's invitation to open the station. Early in the morning a special train speeded his private car to Monte Grande, and accompanied by four of his ministers, the governor of the province of Buenos Aires and numerous other high government officials, the president journeyed by automobile from the railroad five miles out to the station proper.

After being conducted over the entire transmitting installation by Engineer Eugene Reinhard, the technician in charge of the construction of the station since its beginning, the President set in motion the automatic transmitter which sent five special messages, four to the chiefs of state of the United States, Great Britain, France and Germany, and one to the heads of all nations of the world possessing receiving stations.

President Alvear's message to President Coolidge read as follows:

To His Excellency the President of the United States of America.

Mr. C. Coolidge,

Washington.

On the occasion of the inauguration of the ultra-powerful radiotelegraphic station at Monte Grande, the President of the Argentine Nation has pleasure in sending to the president of that great friendly nation his best wishes and the expression of the sympathetic regard of the Argentine people, whose democracy stands solidly beside that of your vigorous republic in the noble task of struggling for the material and cultural betterment of America.

Alvear,

President of the Argentine Nation.

Similar expressions of amity and esteem were contained in the other messages.

In replying to the address of Engineer Eduardo Huergo, President of Transradio Internacional, on the occasion of the inauguration, the chief executive said that it gave him the greatest pleasure to be present at such a demonstration of national wealth and power, which placed the Argentine on a par with the foremost nations of the world in the matter of radio communication, and undoubtedly Monte Grande would be called upon in the future to perform great services for the country. He added that Argentina in following the desires of its great founders and leaders, had always welcomed to its shores the sons of other nations without discrimination, and that Monte Grande constituted a demonstration of the good resulting from such a tradition, uniting as it did different races in an undertaking for human progress which without such a fusion of capital, purpose and energy, would have been impossible.

Toasts to the success and prosperity of the new national company were drunk, and that very evening commercial traffic commenced to flow in both directions with New York, Paris and Berlin. The direct circuit with England only awaits the building of a complementary station by the Marconi interests.

The Monte Grande transmitting station is built upon a plot of land containing more than 1,400 acres, the property of the company. The antenna is supported by ten 210-meter steel towers, in two lines, five hundred and fifty yards apart, each tower being an equal distance from its neighbors. More than nine miles of steel cable were used in guying the towers and the 32-wire antenna contains twenty-five miles of copper. The earthing system consists of a great underground net of copper, a total of sixty miles of wire having been employed.

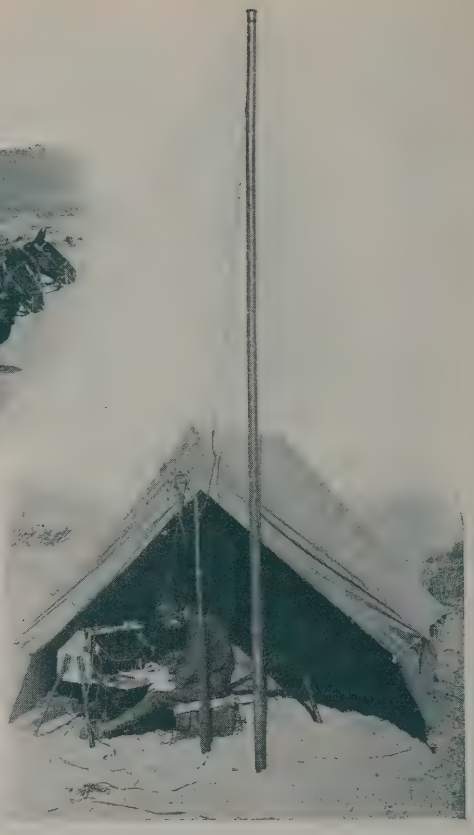
Electrical power is carried to the station by eight miles of underground cable from the sub-station at Banfield. At a tension of 12,500 volts, more than 1,000 kilowatts of energy is carried by this line. The normal antenna charge is from 400 to 500 kilowatts, produced by alternators giving a primary frequency of 6,000 cycles per second. Frequency transformers and condensers permit the use of various wave lengths between 6,400 and 27,500 meters.

At Villa Elisa two receiving systems are being installed, reception being had meanwhile by means of a gigantic temporary loop. One system employs two great goniometers some 75 meters high, a mile apart and connected by a subterranean cable with the receiving station at the center. The other combination uses three small flat-top antennas, 30 meters high and 700 yards apart, all built on the great circle passing through Paris, with the receiving station in the middle.

The city office, nerve center of the entire system, is connected to the transmitting and receiving stations by an eighteeen-pair underground cable,

(*Continued on page* 80)

Crowd returning from inspecting the station. The President of the Argentine Republic is seen in the center foreground, with Engineer Reinhardt (hat in hand) construction engineer of the station, just behind him



Cavalry Pack Radio set carried by a mounted section in the field, and housed in a tent in camp

How United States Cavalry Uses Radio

Radio links up trotting columns across the prairie. Used in warfare practice. Enemy spy destroys tubes

By Garland C. Black

First Lieutenant, United States Army, Signal Corps.

WITH the increased use of radio in the commercial world it will no doubt be of considerable interest to the readers of THE WIRELESS AGE to note the extent to which our Army, particularly the Cavalry, is employing radio telegraphy as a means of communication between troops in the field. While most of us are familiar with the army radio net which links together the various posts widely scattered throughout the United States and our possessions, and have probably listened-in and copied many of these stations, still very few realize the large number of radio sets in use by troops for maintaining communication in the field.

In this connection it is interesting to review the manner in which these sets functioned and the uses made of them during the annual field maneuvers of the First Cavalry Division. The maneuvers took place down on the Mexican border in a sector known as the Big Bend Country of Texas. Various component parts of the division are stationed along the border from Fort Bliss (El Paso), Texas, to Fort Clark (Bracketville), Texas, a distance of approximately four hundred miles. It was necessary that these different organizations be concentrated at Marfa, Texas, in the heart of the Big Bend, as a starting point from which to engage in the tactical exercises. The maneuver as a whole was divided into three parts, namely the march of the troops from their home stations to the maneuver area, the tactical problems in the Big Bend District, and the return march to home stations.

Throughout all stages of this period it was absolutely essential that all elements of the division be in daily communication with one another and that the division headquarters be in touch with the Corps Area Headquarters. It was impossible to take advantage of commercial telegraph to handle this traffic as the troops were only in the vicinity of this service a small part of the time, and too, the cost of this means would have been prohibitive. Hence it was necessary to rely upon the field radio sets.

Communication on the march was handled by employing stations at Fort Bliss, Fort Clark, and Camp Marfa and with each of the three marching columns which made up the command. These columns were made up of the First Cavalry Brigade which marched from Fort Clark, the Second Cavalry Brigade which marched from Fort Bliss, and Division Headquarters and auxiliary troops which also marched from Fort Bliss. These columns marched an average distance of two hundred miles each and as the radio sets with which the troops were equipped have a working range of approximately one hundred miles and the time of the year being rather poor for operation due to unfavorable atmospheric conditions, it was necessary to establish two relay stations. This was done by sending sets in motor trucks to points about midway between Fort Bliss and Camp Marfa, and between Fort Clark and Marfa. These relay stations continued in operation until their column arrived at the place where they were set up, at which time they ceased to function and joined the column. This scheme worked very satisfactorily and traffic was well handled. In several instances when the atmospheric conditions were favorable it was found that the sets accompanying the troops could work through without the use of the relay stations.

While the division was engaged in the tactical exercises in the maneuver area the radio fulfilled a two-fold mission. In addition to furnishing a means of handling traffic for the various commanders it was also employed as a means of communication for the umpire system. The division was divided into two forces, the Browns and the Whites, and these pitted one against another. All problems were controlled by a chief umpire who had an assistant chief umpire with each force and these in turn had numerous assistants assigned to the various units of that force. All messages handled between umpires were in code so that they were unintelligible to the troops, which prevented them from getting information of their "enemy" in an unauthorized way. This scheme afforded a very valuable opportunity to the

umpires. Not only did the chief umpire who was probably located at some place where he could view only a portion of the action know in detail what was taking place on both sides continually, but also the assistant umpires were familiar with the situation confronting the unit to which they were assigned and could better judge the manner in which the situation was handled by the commander they were observing.

Thus it is readily seen that this is another instance where radio telegraphy has played a large part in helping to make an undertaking successful which would probably not have been so without the use of radio.

There were several other instances where radio entered into the events of the day in an interesting way. During the world baseball series results of the games were received at division headquarters play by play over a commercial telegraph line and in turn broadcast from there by radio telegraph so that all the units of the division were able to tune in and enjoy the games.

Another time there was a troop of cavalry detailed to go on a long reconnoitering mission. A pack radio section was detailed to accompany the troop in order that the brigade commander might be in constant touch with it. They had great luck in their mission and kept pushing up closer to the enemy; several prisoners were captured and some valuable information obtained as to the enemy's positions. However, the enemy soon found out that this detachment had a radio set and sent a man out who was to let himself be captured and then after being in the troop's camp to put the radio set out of order. The prisoner not knowing much as to the whys and wherefores of radio was at a loss how to put the radio set out of order after he was in the camp. Nevertheless he waited till after dark and being paroled with the freedom of camp he watched for his opportunity and when the operator left the station for a few minutes he managed to break all the tubes. And while he was ignorant as to the amount of damage he had done, still in his overzealousness to carry out his orders he had certainly rendered the set unserviceable for that day. And later when the troop commander decided to remain in his position over night, instead of being able to use his radio to report his plans to the brigade commander and to request food and forage for his men and animals he was forced to send a messenger about ten miles with a written message, and supplies did not reach them until late that night.

The pack radio set used by the Cavalry Division set up for operation under field conditions

The Radio Fan—à la Milton

By Spencer S. Prentiss

Hence, loathed, noisome duties,
Of teachers, furnaces, and flivvers born
In home and school forlorn,
'Mongst books and Fords and all else lacking beauty.
Find out some uncouth hole
To live in foulest Hades, black as coal.

But come, thou Pastime, free and fair,
Born of knowledge new and rare,
With thy tubes and jacks and plugs,
Oh come, thou joy of Radio Bugs!

Success that comes with any trials,
The joy of mounting knobs and dials,
The test of circuits old and new,
The fight to make the old junk do,
These are the pleasures I would court
And find in thee, thou greatest Sport.

The bell that sounds the joyous call
That rings in liberty for all
Permits me go as fast as might
To charge my batteries for the night.
And then until the evening meal
I work to overcome each squeal.

At eight o'clock the local stuff
I always tune in well enough;
In fact so well they always drown
The stations from without the town.

But when at last they leave the air
I get the distance great and fair.
I hear New York, St. Louis too,—
It's great what one tube sets will do.
As hours get large and then get small,
The middle states, I hear them all.
The lark begins its song and flight,
Proclaims abroad the death of night,
When wearily at last I climb
To downy bed and sleep sublime.

Home-radio idea extended to apartment house. Operator tuning 4-tube set that connects with 72 apartments

Some Prominent Broadcasters

Miss Winifred Ayres broadcasts talk on sport clothes from Atlantic City

Hughes broadcasts keynote speech at N. Y. State Republican Convention

Chancellor Marx, of Germany, employs radio to good purpose

Former Senator Chauncey M. Depew appears before the microphone

The Human Ear and Radio Reception

First Instalment of a series of articles on

SOUND

IN ITS RELATION TO RADIO

By John P. Minton, B.S., Ph.D.
Consulting Engineer, Technical and Test Department, Radio Corporation of America
Fellow, Institute of Radio Engineers and American Physical Society

THE transmission of ideas or the communication of intelligence is one of the most important functions of all those performed by the human race. The social development of the whole family of races on the earth has been made possible largely through this channel of advancement. All this has been made possible by the ear and the voice with which nature has endowed us. This development and application of these two organs, extending down through the ages, has been long and tedious. Gradually, however, the process of spoken words evolved as man developed conscious control over those parts of which the mouth and throat are composed.

Over this period of time of perhaps many hundreds of centuries, a simultaneous development of the use of the human ear kept pace with that of the voice. These two developments must of necessity have occurred simultaneously because they came about as a result of the necessity for the transmission of ideas of intelligence from one individual to another. We can readily imagine the confusion which would have occurred had not both developments gone hand in hand. Our helplessness is altogether too distressing even now when we find ourselves among foreign people whose language we may understand with great difficulty or not at all.

Our languages today may not be even remotely connected with the first sounds spoken by the voice and recognized by the ear, as pertaining to a definite communicated idea or thought. The natural barriers with which nature has separated one tribe or group of people from another caused the development of numerous different languages, dialects or spoken and recognizable sounds, whichever way we choose to designate them. No doubt these developments of numerous languages occurred among the various groups of people simultaneously, but, of course, at different rates and in different ways depending on the characteristics and environment of the various groups. These likenesses and unlikenesses of the languages and dialects have continued down to the present time. Radio broadcasting, however, is destined, I believe with others, to change ultimately this whole state of affairs.

Broadcasting Will Bring World Language

In Europe where there are many countries scattered over a small area, speaking in terms of distances used in broadcasting, there is already a recognizable need, which may become pressing, for a common universal language. The use of a common language is certain to come and because of the rapid development of broadcasting in America and England it is my prediction that the universal language will be the English language. Thus, after many centuries when "The Lord did there confound the language of all the earth" the curse will have been removed and again we may say "And the whole earth was of one language, and of one speech." Let us hope the human race has at least developed sufficiently during these intervening centuries that it will not again try to "build a tower, whose top may reach unto heaven," and cause the destruction of our new universal language for whose acquisition radio broadcasting will be responsible!

Dr. John P. Minton engaged in testing the acoustic properties of loud speakers

There is no scientific reason why such a universal language cannot be used throughout the entire world. In all of them the same human mechanisms, the voice and the ear, are used. These two delicate organs are the vehicles which have made possible the carrying of ideas originating in one mind to the minds of other people. They play the leading rôle in radio which is, itself, a link in this scheme of transmission of intelligence. Of course, we take the voice, the air and the ear as a matter of fact because we have not developed them. Nevertheless, their development is perhaps much more wonderful than radio which has been developed by man. Consequently we praise ourselves for the latter and say, "Behold, see what man hath done." The former we pass over without much consideration, until, of course, something goes wrong with the voice or the ear. This group of articles, therefore, on the general subject of acoustics, acoustical apparatus and the transmission of intelligence as they are involved in radio broadcast and reception is not only timely, but of considerable general interest to the radio public. Such articles, of course, as we shall present are based on the highest type and most recent results of physical research covering these fields of investigation.

The Ear Is Part of the Receiver

The human ear is as much a part of a receiving set as the loud speaker or head phones are. The former are taken as a matter of course, the latter two, however, since they were developed by man, are considered intimate parts of the set itself. Faults in the former, however, are far more serious than in the latter. In the latter cases the apparatus can be discarded for new ones or themselves repaired, but in the former case repair or improvement can scarcely be hoped for even with the help of the best medical skill obtainable.

Sound Is the Instrument That Radio Plays Upon

The following brief description of the normal ear will be sufficient to make it possible for the reader to readily grasp the results which will follow. The ear consists of three main parts, known as the external, the middle and the internal ear. The former is familiar to us all and consists of the external lobe, the ear canal and the small drum membrane at the end of the canal. For most people this is about all there is to the ear. This is far from the truth, of course. The accompanying sketches, figures 1 and 2, illustrate the construction of the external ear, as well as the middle and internal ears, all in their proper relation to one another.

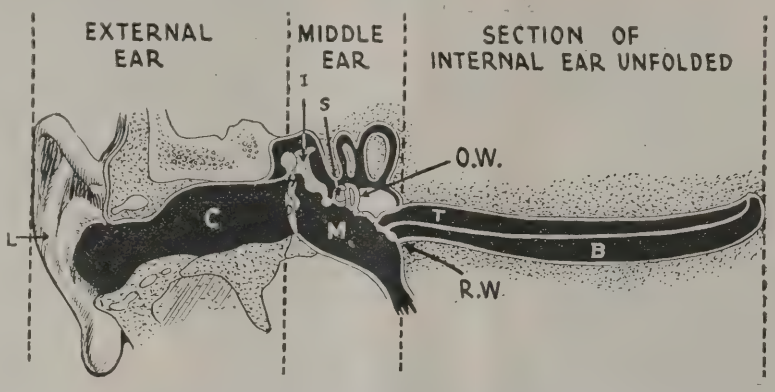


Figure 1—Diagram of Ear. L—Lobe; C—Canal; D—Drum Membrane; H—Hammer; I—Incus; S—Stirrup; M—Middle Ear Cavity; O. W.—Oval Window; R. W.—Round Window; T—Tectorial Membrane; B—Basilar Membrane

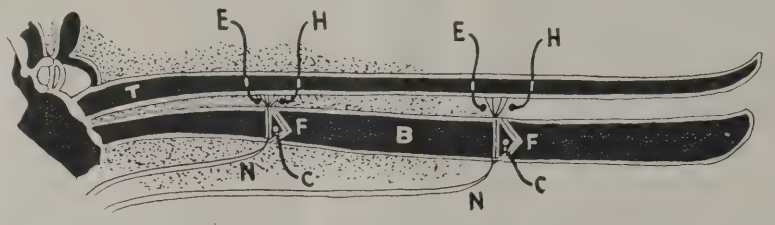


Figure 2—Diagram of Internal Ear unfolded showing two of Cortis Arches. T—Tectorial Membrane; B—Basilar Membrane; F—Basilar Membrane Transverse Fibers; C—Cortis Arches; H—Auditory Hairlets Projecting Against Tectorial Membrane and Connected to Nerve Endings; E—Nerve Endings; N—Auditory Nerves

The Construction of the Ear

The canal of the external ear is about one inch long and the drum membrane closing off its interior end is about one-quarter of an inch in diameter and concave with respect to the exterior lobe. That is, the drum is bowed away from the exterior toward the middle ear cavity as shown by the sketch. The middle ear consists of three tiny bones, H, I and S. The first bony lever, H, called the hammer, because of its peculiar shape, is attached to the drum. The third tiny bone of the series, S, is called the stirrup because of its resemblance to a stirrup. This stirrup is connected to the hammer by means of the connecting link, I. The other end of the stirrup is connected to a thin membranous substance called the oval window of the wall of the internal ear. This membrane window is about one-quarter of an inch in the direction of the longer axis and about three-sixteenths in the direction of the shorter axis.

The internal ear leads off from the oval window. It is an extremely complicated, delicately constructed and a wonderfully acting piece of human mechanism. Encased in its own hard bony structure, well within the bony walls of the head, it is completely protected from injury due to external causes. The main feature of the internal ear which is of interest to us at present is the small membrane with a few thousand transverse fibers. The bony structure containing the internal ear mechanism resembles a small snail shell which is about one-quarter of an inch at its base and about the same height. The basilar membrane containing the many transverse fibers is wound around the snail shell throughout its entire length and divides the interior of the shell into two compartments each filled with liquid. The length of the fibers varies linearly from

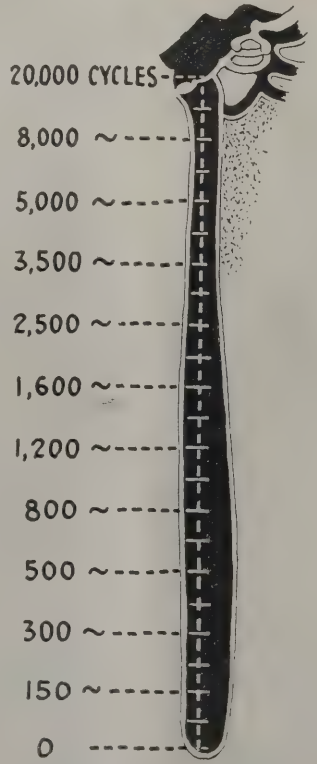


Figure 3—Locations of Various Frequency Regions on Basilar Membrane. Distance from Oval Window in Millimeters. (Total Length — 31 Millimeters — 1.22 Inches)

The Ear Is As Important As the Radio Receiver.

the small oval window where the shortest ones are located to the remote end of the shell where the longest fibers are found. The length of these fibers varies from about 0.05 of an inch to 0.15 of an inch. All of them are covered over by a thin membranous substance to prevent the passage between them of liquid from one compartment to another.

Midway from the ends of each of these fibers is attached one foot of a small bony arch, the other foot being connected to the end of the fiber where it joins the bony projecting wall of the internal ear. The accompanying sketch, figure 2, will serve to illustrate the constructional details. The sketch also shows the auditory hairlets projecting out from the apex of the arches. Above the arches is the tectorial membrane against which these thousands of little hairlets move and cause auditory stimuli to be excited in the nerve endings in which the hairlets terminate. These stimuli are carried from the nerve endings, through the auditory nerve cells and thence along the thousands of auditory nerves to the acoustic center in the brain. In this construction of the internal ear we see that there are several thousand transverse fibers in the basilar membranes. There are a corresponding number of cortis arches and several times this number of auditory hairlets, auditory nerve endings, nerve cells and nerves, all of which are laid out in a linear fashion and all of which function in a beautiful manner as revealed by recent physical research, to which the writer has been able to contribute in some degree as a result of his own extensive researches.

How the Ear Analyzes Sound Waves

Having presented a sufficiently comprehensive description of the ear for our purpose, let us see how it is possible for the ear to perform the most remarkable and astonishing function imaginable. I refer to the analysis or separation of sound waves, no matter how complex or mixed up, so to speak, into their component parts, so that the brain and mind can perform its even more remarkable function of the co-

ordination and interpretation of the auditory nerve stimuli.

No matter how simple or complex a sound wave, it is nothing more or less than rarefactions and condensations of the air; that is, a decrease and an increase of the normal air pressure in the atmosphere. These changes in air pressure are brought about by some vibrating body, such, for example, as a violin string, a piano sounding board, or a vibrating column of air like that enclosed in an organ pipe. These increases and decreases in air pressure are propagated away from the sounding body in all directions. They constitute a sound wave and the ear drum responds to these minute changes in pressure.

The air in the middle ear is confined and maintained at a constant pressure equal to the average air pressure in the outside air. The pressure changes causing the sensation of sound enter the ear canal and cause corresponding pressure changes on the ear drum. The ear drum is caused to move back and forth, or to and fro, in actual bodily vibrations. The motion of the drum is passed on by means of the chain of hinged bones to the liquid of the internal ear. The liquid moves back and forth in unison with the drum membrane. Motion of this liquid in turn causes the transverse fibers of the basilar membrane of the internal ear to vibrate back and forth. This motion in turn moves the bony arches attached to the fibers and thus causes the auditory hairlets to stimulate the nerve endings. Nervous energy, perhaps electrical in form, is thus released and sends a definite auditory stimulus to the brain, which in the final analysis is the wonder of the whole operation because it must interpret these auditory nerve stimuli and translate them into concrete ideas. Thus, the remarkable and unexplainable process occurs in the brain.

A single pure tone, such as is produced by the mouth during the expulsion of air out through a small orifice formed by the lips, sets up air

Study of Radio Includes a Knowledge of the Ear

pressure changes which follow the simplest known form of vibration, called sine wave vibrating or simple harmonic vibrations. These pressure changes cause a corresponding motion of the drum membrane, which motion is communicated to the fibers of the basilar membranes of the internal ear. If the tone is a high pitched one, those fibers in the region of this membrane nearest the oval window are affected more than any other region. The lowest pitched tones affect most the fibers farthest removed from the oval window; that is, those fibers at the most internal part of the internal ear. The former fibers are the shortest ones and correspond to the high pitch region, while the latter are the longest ones and correspond to the low pitch portion. The arrangement, then, is similar to the layout of strings of the piano and is illustrated in the accompanying sketch, figure 3. We can see, then, how the numerous different tones set up when an orchestra is playing in combination with a chorus of many voices produce a most complex pressure change on the ear drum, how the corresponding motion of the drum membrane communicates its motion through the tiny middle ear bones to the basilar membrane of the internal ear, and finally, how the basilar membrane separates or analyzes the complex pressure changes into the hundreds of different simple harmonic changes each of which are finally transmitted by its own individual auditory nerve to the brain. The internal ear, then, with its several thousand individual parts in combination with the several thousand auditory nerves perform this remarkable and astonishing function of analysis of any sound or combination of sounds no matter how intricate and complex they may be. No other organ of the body performs any function so marvelous.

CHARACTERISTICS OF THE EAR

In order that we may have some definite concrete impressions to retain about the operation of the ear let us present briefly a few of the physical results which we have obtained to represent the average performance of a large number of ears.

1. There is a lower limit of the pitch of a sound below which the ear cannot hear. This lower limit is in the region of 20 complete vibrations per second. The reason for this may be that there are no parts of the internal ear to respond to this pitch or it may be due to the fact that the stiffness of the vibrating parts of the whole car is too great for these low frequencies. The analogy is similar to a head-phone diaphragm being unable to vibrate at these very low pitches because of its stiffness. Again the cause may be due to the liquid motion of the internal ear being shunted around the basilar membrane and thus exerting no pressure on this membrane.

2. There is an upper limit of the pitch of a sound above which the ear does not hear. This upper limit is about 20,000 complete vibrations per second. The cause of this upper limit as well as the lower limit is largely a matter of speculation. There may be no parts to vibrate at these high pitches or the weight of the whole ear system may be too great to follow such rapid changes in the pressure, acting on the drum membrane.

3. There is a minimum intensity of sound below which the ear cannot detect the presence of any auditory stimulus, or if it does, the brain cannot be stimulated by it sufficiently to bring it into consciousness. This lower limit of audition varies with frequency in accordance with the accompanying curve (see lower curve, figure 4). The air pressures are shown in dynes—a dyne corresponding to about one-five hundred thousandth of a pound.

4. There is a minimum intensity of sound above which the sound pressure

(*Continued on page* 86)

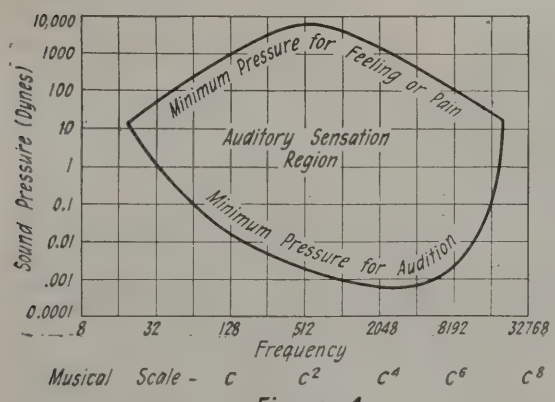


Figure 4

Limits of upper and lower audition

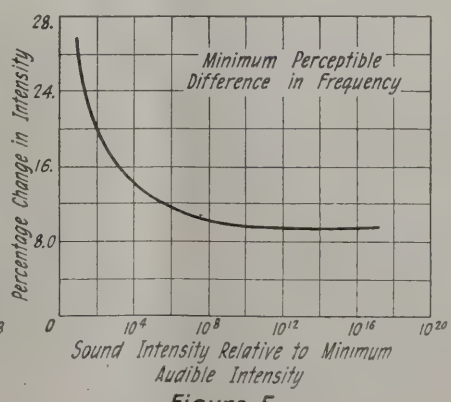


Figure 5

Graphic curve of intensity increments

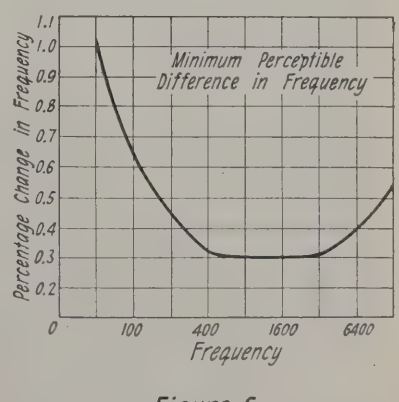


Figure 6

Relation of pitch discrimination to wave frequency

The Radio Joys of a Camp

The Companionship of Friends in the Open Air With Radio

By Sinclair Arthur

FOR several years Dr. Hobart and I have had a camp on Rye Lake. Every week-end, winter and summer, we go to the "shack" for a rest from the stress of city existence.

Our shack is a corrugated iron cabin with a large living-room, a kitchen and a screened sleeping porch. The interior is finished with bark woodwork. Strings of tiny pine cones cover the cupboards and hang in the doorways. A large stone fireplace in the living-room and the kitchen range furnish enough heat to make the shack cozy in the coldest weather. During the hot summer months we live on the open porch, going within only for our meals. Our location is on a high point overlooking the lake with dense woods surrounding the other three sides. The exposure is right for a constant breeze throughout the torrid days of July and August.

A flower garden planted in stone terraces surrounds the shack. Winding paths, rustic benches and stone seats add a touch of artistry to our garden in the heart of the wild.

Of late, we have enlivened this retreat with radio. The ever changing programs of music and sports bring to us a touch of the caprices of the world beyond.

* * *

"Why is it," Dr. Hobart demanded, "that my patients button-hole me to spend the week-end at their surburban homes?"

We were sitting on the screened porch listening to the strains of "Raggedy Ann" broadcast by Paul Whiteman's Orchestra from WEAF.

"It seems so foolish," he continued, "I have to sample their home-brew, sleep in their uncomfortable guest rooms, and get up early Sunday morning—not because I am awakened, but because I feel guilty after listening to footsteps for an hour—simply to visit the garden, hear a long-winded dissertation on why beet seeds are planted, or sowed, or whatever you do with beet seeds, then to the attic, down to the cellar, and after dinner, sight-seeing around the village square."

Dr. Hobart had a pained, quizzical expression that seemed to concentrate in a frown just between his eyebrows.

"Why is it," he demanded again by way of emphasis, "that I must always be the sacrifice of good intentions? Do you suppose my being a bachelor has anything to do with it?"

When I had managed to regain a decent composure I ventured a guess that he was merely a party to his own outrageous tactics. Doc will insist upon dragging his friends up to our camp, sublimely unconscious of any possible reluctance on their part.

* * *

At the Grand Central Terminal in New York, take the New York Central to White Plains. Buy your groceries at the general market, stagger aboard the one-man trolley, and get off at Silver Lake. Then embark in a taxi and direct the driver to Birch's Camp—just below Carpenters'. The drive is only three miles through tree-lined back roads.

After you have paid your fare, climb the rock-studded bank on the right and follow the path that winds through heavy underbrush. You can't possibly lose your way. The path leads up over ridges, down through swampland and finally brings you abruptly to the foot of the stone steps leading up to our camp. That is to say, if you have been able to struggle through the swarms of gnats and mosquitoes (with both arms full of supplies) and managed the two-mile tramp without succumbing to heat prostration, or some one of the other tortures of the trail. Of course your hat has been knocked off by low-hanging branches and your shoes ooze-coated with swamp-mire and rock-scratched. But you have encountered comparatively few other discomforts, except a little mud spatter on your new summer suit.

Having arrived, you deposit your bundles on a rustic bench, mop your brow, the while critically examining your disheveled arrangement, and finally—according to your nature—reconcile or resign yourself to the rigors of the untamed woods.

You will then, and surely, become enraptured with the sweep of view across the chain of lakes and woodland

CAMP CAUTIONS

In camping with a radio, if your receiver is one of the antenna type, erect your aerial wire from the camp to a branch of one of the tallest trees in the immediate vicinity. If thunderstorms are prevalent, it will be found advisable to erect an additional antenna not over ten to twenty feet off the ground. That type of aerial is not so readily influenced by atmospheric disturbances. An aerial of this character can be of any length from 100 to 200 feet.

See that you have a good ground connection. If such cannot be obtained at the camp, the equivalent of a good ground connection can be had in the use of a piece of wire 100 to 200 feet in length laid over the surface of the ground and directly underneath the aerial.

Receiving apparatus in the camp should be duly protected from moisture and dampness.

The electrical constant of aerials erected in a camp, may be quite different from the electrical constant of the aerial used with the same set at home. This means that stations formerly heard at home will not come in at the same point on the dials in the camp. It should not be difficult to locate new positions for such sets after the first evening's operation.

stretched below and melting into lavender outlines on the distant horizon. Off to the right you can see a white ribbon — a road — winding around and up a green mound. Across, and away to the left on the shore of the furthest lake, the corner of a secluded monastery peeps through the branches of a thick verdure. At your feet, mountain laurel, scrub oaks and dogwood, all in a scramble, recede to the shore of Rye Lake. A great rock here, and a pine tree there, mark the tenacious grip of the wild on the stealthily creeping fingers of the cultivated regions beyond.

Once you have drunk your fill of nature in its virgin glory, you will pause to wonder that you were capable of such a thirst.

Then you may enter the cool, "woodsy" interior of the shack and step out on to the screened porch. There you will find Dr. Hobart and I comfortably ensconced in wicker chairs, our pipes simmering, and our lazy minds occupied with the broadcast sports on our radio.

"Hello there, old-timer!" will probably be the Doc's greeting. "Come on out on the bleachers—batter's up!"

* * *

After a supper of juicy sirloin steak, crispy French-fried potatoes, sliced onions and lettuce, and real coffee, we light our pipes and listen to the Dinner Dance Orchestra broadcast from WOR, basking in the comfortable indolence of appeased appetites. Our dormant inclinations having been humored, we dash down to the lake for a plunge—back again—and standing on a rock still warm with the day's sun, we rub down with a Turkish towel, laughing and bantering under the luxurious stimulant of carefree camp existence.

We then push our folding beds out on the porch, set the radio, turn off the lamp, and settle down to an evening of music in the quiet sanctum of a dense wood.

The carpets of grass and moss are bathed with a mellow glow of silvery moonlight that streams through the branches, casting shadows about in spectral fantasies. A refreshing breeze rustles the leaves. The glow and flare of a pipe, an occasional murmur, seem to emphasize the companionship of friends in the peace and rest of the open air.

* * *

We are awakened by a phoebe bird calling its mate. The clear morning air is washed by the early sunlight and is intoxicating. Dew-crystals gleam on the rose petals. Everywhere life has awakened to the invigorating freshness of a new born summer's day.

Down to the lake and out in a boat we fish the morning through. Our radio is not tuned until Sol rides over the zenith and time has lengthened out to a blazing afternoon.

After dinner, we sling the portable receiver over our shoulders and set off for a hike through the woods. Wherever we stop, the radio is played. Part of the time our fun is had in little more than experimenting, trying for this station and that station, always delighted with a newly discovered trick in wayside reception. Often, we find a sheltered nook where we may rest and enjoy the baseball game broadcast from a distant city. But always, we find our old byways and haunts the more pleasing because of our radio.

As evening approaches, we build a fire for a camper's meal. With bacon and toast, fire-baked potatoes and coffee, and "Roxie" on the air, we learn of the joys of camping life—a truly pleasant life enhanced with the broadcast programs of music and sports.

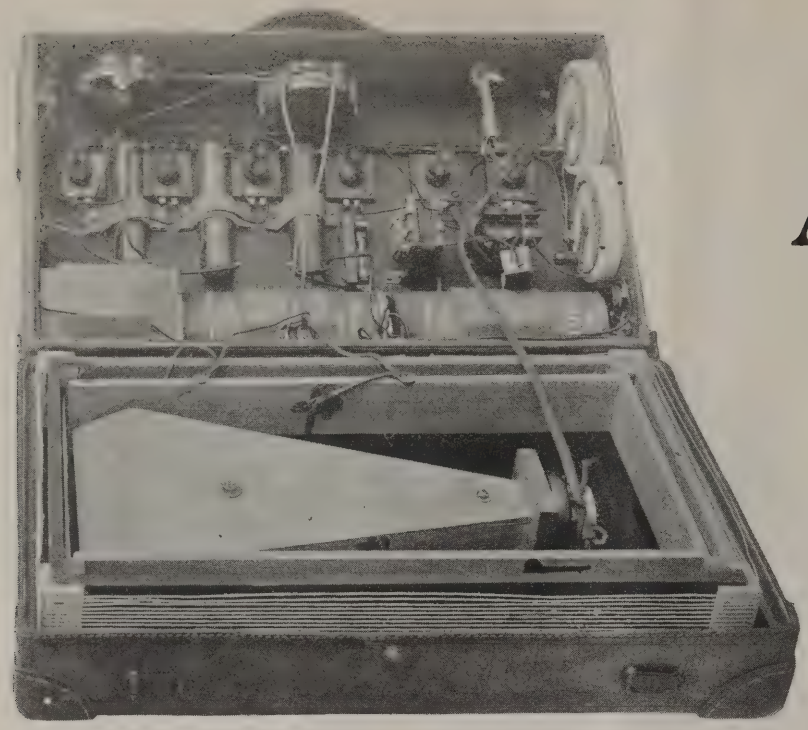
* * *

"And now," the Doc exploded as we prepared for another radio evening on the porch, "tell me that your friends didn't enjoy this week-end more than they would looking over the village library and meeting the boys of the volunteer fire-department."

Rain pattered on the corrugated iron roof. A fresh, cool wind had come up, forcing us under the covers. The deep intonation of an organ prelude broadcast from WGY kept time with the staccato rhythm of the rain drops. I thought of the remarks I had heard—expressed at random—but always centered around the associations with which each was most familiar.

"To tell you the truth, Doc," I replied, "every blessed one of them used this week-end for a basis of comparison. What they most enjoyed were the attendant discomforts of our particular camp. They will now go home to their own radio sets, and between times of tuning, will think of reasons why it would hardly do to visit us up here again. They all have their own ideas about what a camp ought to be like."

The sets used in this camp are THE WIRELESS AGE 3-Tube (described in March issue) and THE WIRELESS AGE Uni-Control (described in December issue). Results in all cases were satisfactory with an aerial wire thrown over a high limb of a nearby tree.



Approved

The WIRELESS AGE "Uni-Control" in a Bureau of Standards Package

By S. R. Winters

No antenna; dry cell batteries. You can use it immediately in hotel or camp

Simple to operate; only one control. Powerful amplification provided. Sensitive and selective

IF you are a devotee of Izaak Walton and go a-fishing this summer, or if you are among the multitudes that camp on the 156,000,000 acres of woodland reservations of the Federal Government, radio entertainments may attend your out-of-door recreational activities. This assurance does not imply that your "excess baggage" limitations will be exceeded by the inclusion of 100 feet of antenna wire, storage batteries, a loud-speaking horn, and a cabinet for containing the radio instruments.

These things, in a manner, are provided. But, with the refinements in the manufacture of vacuum tubes which makes possible their operation from dry-cell batteries, there has been introduced the compact radio receiver. In fact, so little space is required for a complete radio receiving set that all the necessary units may be enclosed in an ordinary leather suitcase. This portable outfit, sometimes referred to as a "Portafone," was designed and built by the Radio Laboratory of the Bureau of Standards, United States Department of Commerce.

Self-contained, is the word fittingly descriptive of this equipment, since not only the vacuum tubes, batteries, transformers, and wiring are enclosed between the covers of this suitcase but a loop antenna and loud-speaking unit are similarly accommodated. The latter two units are contained in one section of the suitcase. The loop or coil antenna is simply constructed, consisting of a square wooden frame around which are wound twelve turns of fine wire. The loud-speaking unit is built of wood and fits snugly in the open framework of the loop antenna.

This self-contained radio-telephone receiver is comprised of three stages of radio-frequency, two stages of audio-frequency, and a detector. The types of radio-frequency and audio-frequency transformers used in this portable outfit duplicate those employed in the set built and demonstrated by THE WIRELESS AGE in its laboratories several months ago — that is, the former were made by the Radio Instrument Company and the latter by the General Radio Company. The type of electron tube originally used in this suitcase receiver was Radiotron WD-11, but Radiotron UV-199 is preferable. The low filament consumption of the latter makes it especially adapted to service in portable outfits where the number of batteries used are necessarily reduced to a minimum. For instance, two dry-cell units are employed for "A" batteries in this particular equipment. Of course, dry cells are used for the "B" batteries since the transportation of storage batteries would contribute materially to the weight and cumbersomeness of any portable outfit.

Once the covers of this suitcase are shut, the contents are cleverly disguised. Other than two tuning controls placed near the handle of this leather container, the knobs or rheostats are not markedly discernible, the outward appearance is conspicuously absent of any radio "ear marks." It is not excessively heavy, weighing probably less than 50 pounds, and may be carried about from place to place as if it only contained wearing apparel, the original purpose for which this container was designed.

This compact receiver meets the demands of summer—when radio goes to the country. The pleasure of receiving concerts in a remote region, a hundred miles or more removed from a broadcasting station, is not to be discounted. However, as great an outdoor sport as this may be, the merriment caused by introducing this suitcase radio receiver in a village unacquainted with the marvels of radio telephony is even greater.

This "Portafone" is a convenient method of taking radio to the great out-of-doors by the automobile route. In fact, tests have demonstrated its capacity to intercept ether waves and convey speech and music to persons

READERS who are practiced and skilled in the construction of sets will have no difficulty in making this portable receiver, which is worthy of their best efforts and will reward such efforts richly. For those who desire more assistance with the construction, the article describing the construction of THE WIRELESS AGE *Uni-Control Receiver in the December, 1923 number will be very helpful. The latter article, although describing the set as constructed by the designer in a layout different from that followed by the Bureau of Standards, gave minute construction details and valuable suggestions with respect to wiring, testing and operating. Finally, our "Information Desk" is always ready to render assistance.*

Portable Receiver

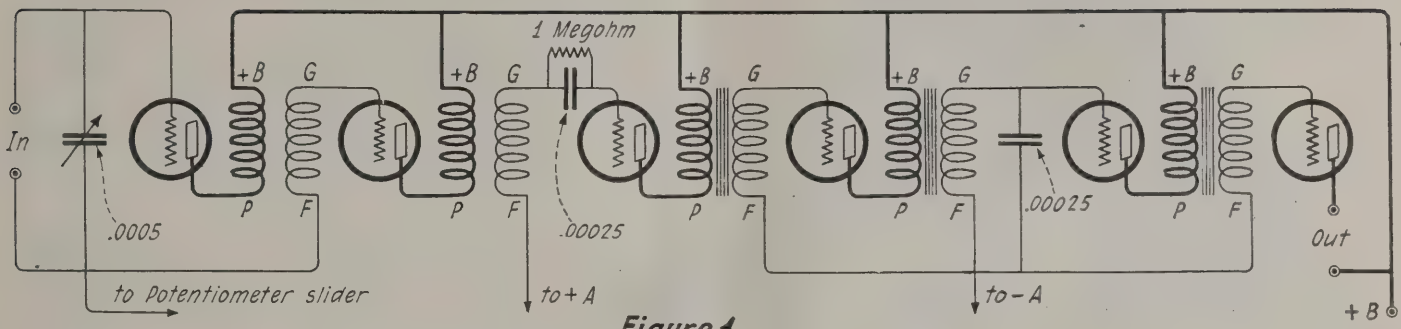


Figure 1

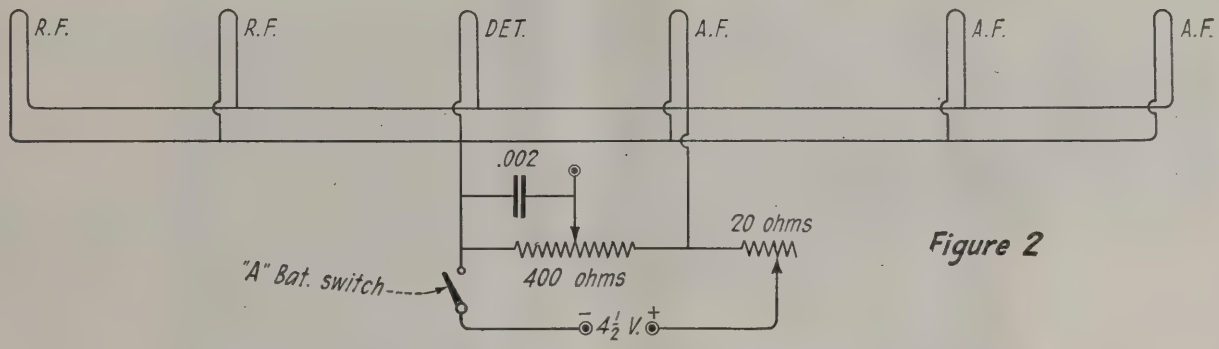


Figure 2

while traveling in an automobile. The experiments were conducted at short range from broadcasting stations and though the ignition of the fuel in the automobile engine was a slight disconcerting factor, the clarity and reliability of the radio signals was unmistakable.

The fisherman, who sits on a bank all the day long anticipating the catch of a big fish, would find this portable outfit a means of relieving the monotony, provided his pastime was negotiated in close proximity to a broadcasting station. The city-dweller, who flees from brick walls, paved streets and clanging trolley cars, for a sequestered spot in the wilderness, may invite the companionship of this "Portafone" for keeping in touch with the civilization he left behind. The automobile tourist with no pre-determined destination in view may hear concerts, news, and the speeches of the great and near-great as he travels, if his suitcase is filled with radio instruments. The Boy Scout, too, need not forsake his hobby when hikes call him over stony ways and through a wilderness. A suitcase, chockful of radio apparatus, is the one connecting link between the city he left behind and the rough-hewn paths which are being explored.

The possibilities of this and similar radio apparatus in compressed forms are too numerous to recount. The portable outfit, whether contained in a suitcase or comprised of several units, is calculated to explode the claim that radio is an exclusive indoor sport. The loop antenna, dry-cell vacuum tube, and the dry-cell battery itself, have brought the country nearer to the city and made of the isolated region a potential radio receiving station.

EQUIPMENT

One .0005 (500 mmfd.) variable condenser with a mechanical vernier.
One 400-ohm potientiometer; the specified resistance is not essential, but it should be as high as possible.
Three audio frequency transformers, all low ratio.
Two radio frequency transformers covering the range of 220-550 meters.
Six vacuum tube sockets.
One battery switch.
One .002 mfd. fixed condenser.
Two .00025 mfd. fixed condensers.
Bus bar, wire, tubing, mounting screws, etc.

ACCESSORIES

One loop wound tautly with 12 turns of solid No. 20 copper wire spaced ½ inch.
Six UV-199 or C-299 vacuum tubes.
One plate battery of 67½ volts.
One "A" battery of three dry cells.
One loud speaker.

The six tubes occupy considerably less room than most one-tube receivers. There are two stages of radio frequency amplification, a detector and three stages of audio frequency amplification; inter-tube coupling is provided through suitable radio and audio frequency transformers.

The circuit is so arranged as to permit the grids of the three audio frequency tubes to be at 3 volts difference with respect to the negative terminal of their filaments; necessity for a grid battery is thus obviated. Moreover, by this arrangement the voltage on the grids of each radio frequency amplifier is the same.

A positive acting cut-off switch and a high resistance potentiometer are the only extra equipment in the filament circuit.

In figure 1 particular attention is directed to the radio and audio frequency transformer connections. On the transformers G and P represent the outside terminals of the secondary and primary winding; F and +B the inside terminals of the same coils.

Great care must be taken that the grid return leads are exactly as shown. On the R.F. tubes they both are connected to the potentiometer slider; on the detector to the positive "A" battery

(*Continued on page* 88)

Gertrude Bryan broadcast from WJZ

Spanish Nights—

French Nights—

Five Language Events—

The Opera "Faust"—

Entertainment *en route*—

The League of American Pen Women—

Detection of Tuberculosis by Radio—

Training for Negro Spirituals

Broadcast Programs Broaden to International Scope

Digest of Outstanding Broadcast Events

IN 1884, George Westinghouse started a small plant in Garrison Alley, Pittsburgh, Pa. He staked his judgment on the alternating current system of electric generation, weathered the spectacular war that was waged between alternating and direct current advocates, harnessed Niagara Falls for electrical power, produced the first successful single-reduction street car motor, electrified great railroad systems, and after a score of other remarkable achievements, erected four first class broadcast stations. Although George Westinghouse did not accomplish all that individually, he was at least the founder and promoter of what the Westinghouse Electric and Manufacturing Company has produced.

* * *

KDKA, the pioneer broadcast station of the Westinghouse Electric and Manufacturing Co., has inaugurated the first real approach to international broadcasting.

The Spanish programs recently started by KDKA are in answer to a real and definite need for such programs as evidenced by hundreds of letters from South America. KDKA has a stable range and the radio listener in Buenos Aires can hear KDKA every night, but if he is an Argentinian who speaks only Spanish, the program is meaningless because it is spoken in English. So the Argentinian writes a letter in Spanish to the program manager telling of his good receiving apparatus, but also stating that he wants to hear a program in his own language.

Such letters come with every mail and after the Westinghouse Company had installed its repeating station KFKX, at Hastings, Nebraska, more letters than had been received before were found in the mail.

Long before the first Spanish program was broadcast, the officials in charge of the station were aware of its international range. When KDKA co-operated with the British Broadcasting stations in relaying its programs first transmitted on the extremely short wave lengths, letters were received not only from the people living in the European countries adjacent to Great Britain, but also from India, Turkey, the Balkans, even the northern part of Africa.

The first program that consisted entirely of Spanish music was announced in both English and Spanish so that the people of the United States would be kept informed of the progress of the program.

For the Spanish programs, one of the employees, Señor D. Santini, whose birthplace was Santa Fé, Argentina, was trained for the announcing.

Mr. T. P. Gaylord, acting vice president of the Westinghouse Company broadcast the opening announcement to the Spanish speaking people of the United States, Central and South America. Señor Corriola, vice-consul of Spain then followed with a message to the people who speak his native language.

The big news associations of the United States carried dispatches on the South American wires previous to the special broadcast. Thus every radio fan in those countries was notified of the day and of the hour.

The government of Cuba ordered all broadcasting stations to shut down during the hours KDKA broadcast in Spanish.

Thus when the great event was under way there was a Spanish-speaking audience whose size probably has never been equaled.

The success of the Spanish program was cabled to KDKA from all parts of South America and Mexico.

Señor F. M. de Stefano, owner and editor of the *"Havana Life,"* the first publication in the world to print radio news in Spanish, dictated a ringing commendation to the broadcast station in behalf of the Republic of Cuba. He also remarked on the clear reception of KFKX which re-transmitted the KDKA program.

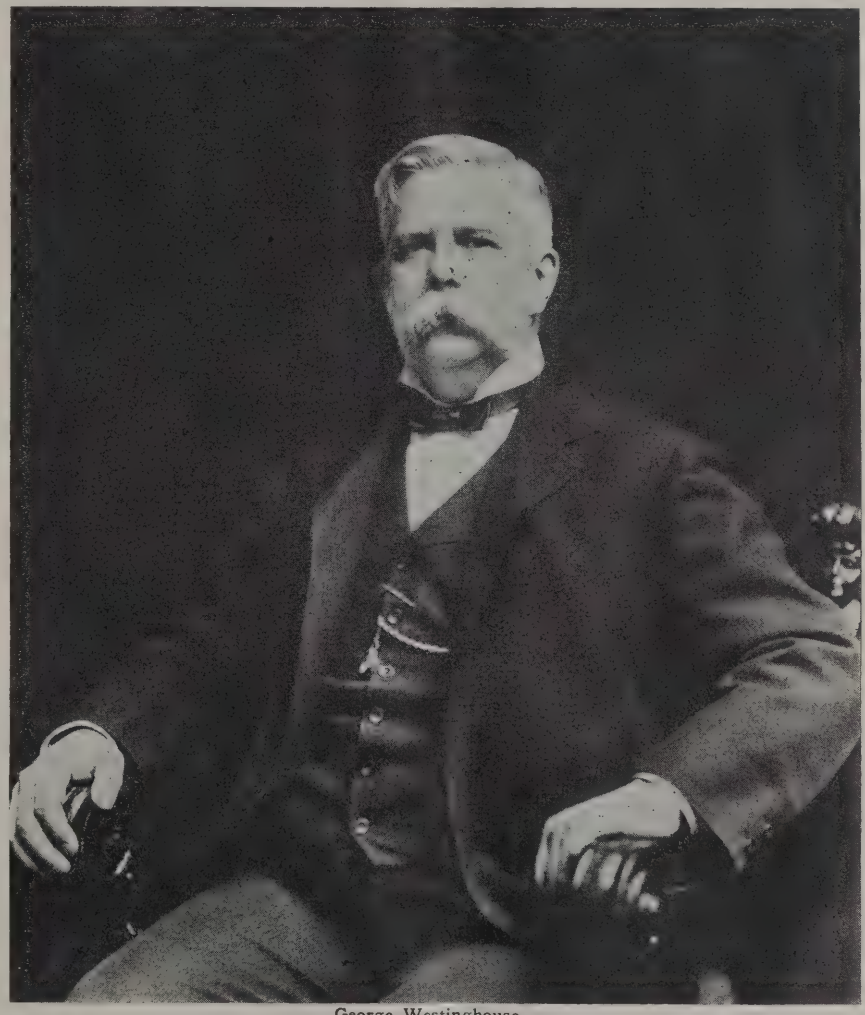
The second program broadcast in Spanish included two former residents of Buenos Aires to feature the program. These artists were the Señor and Señora Narud. Señora de Narud was the former Ada Lia Virasoro, daughter of one of the most prominent families, politically and financially, in Argentina. Señor Narud was born in Christiania, Norway, but later entered the business world in Argentina where he was married.

Again, as on the occasion of the first program, the South Americans plainly heard the programs and responded with thousands of letters of appreciation.

So today Spanish programs have come to be a fixture on the broadcasts of KDKA and will continue to be so for an indefinite period in the future.

Even those who do not understand Spanish should listen in. Purchase a book on the rudiments of the Spanish language, or a book of elementary lessons. Then listen in again. Read about the Spanish peoples. Compare what you learn with what you know about your own people. Ibañez and Jacinto Benevente have written much that is worth while. There is a great deal you can learn through broadcasting.

* * *



George Westinghouse

WBZ recently put over a five-language program in which folk songs, Italian, Scotch, French, Russian and German were featured. The Annual French Program night was broadcast a week later.

* * *

FIRST prize in the Radio Drama Competition conducted by WGY, the Schenectady Broadcasting Station of the General Electric Company, was awarded to Miss Agnes Miller of 150 East 72nd Street, New York, for her comedy drama of business life, entitled "A Million Casks of Pronto."

The object of the competition was to develop a type of play especially adapted to radio presentation, a type of play that will tell its story through an appeal to the ear and imagination just as the screen play is directed exclusively to the eye. Miss Miller's play was selected from nearly three hundred manuscripts as the best original drama submitted and she will receive a cash prize of $500.

Miss Miller is a native of New York. She was graduated from Barnard College and later received her master's degree in comparative literature from Columbia University. For eighteen months, during the war, she served with the United States Naval Reserve on foreign language censorship. Some of her experiences in this work furnished the groundwork for her successful radio play.

WGY was the first station to introduce the drama to the air and the players have offered one production weekly since October, 1922. The radio drama has proven one of the most successful and popular features offered by the Schenectady station. The Radio Drama Competition was inaugurated for the purpose of stimulating interest among writers in what is destined to become a new branch of dramatic art. Writers were advised to bear in mind that the radio audience gets a play exactly as a blind man would receive it in a theater and they were urged to take full advantage of "Noise Effects" as a means of creating atmosphere.

* * *

BROADCAST stations are exerting every means available for the making of programs of a valuable character. WGY launched a contest for radio drama material. WLW staged a Radario contest. Both stations have employed capable directors.

Fred Smith, studio director at Crosley Radio WLW had the good fortune to travel in Europe for eight years. Most of his time was spent in Spain—five years in all—and the remaining three years in France, Belgium, Holland, Germany and England.

During those years Smith spent all his spare time in studying the languages, arts and institutions of the countries where he was living. When he came back to America two years ago he brought with him a wealth of background for the exacting requirements of broadcasting.

Since he has joined the Crosley Staff, Mr. Smith has diligently applied himself to the development of the Radario; the radio play is broadcast from WLW at frequent intervals.

* * *

THE opera of "Faust," arranged by Edgar Wise Weaver and presented by the Women's Glee Club and Orpheus Club of Mankato, was broadcast from WLAG direct from the auditorium in the Mankato armory.

"Faust," created in the distant past, tells the story of man buying wealth and love at the expense of his immortal soul.

Goethe has taken this symbolized being and placed him permanently in literature, while Gounod has sung this

story through years of time and his opera is the most popular of all operas and Gounod's fame rests largely on "Faust."

Faust—an aged philosopher, has grown weary of life in his vain effort to understand the real essence of existence. His vigil lasts through the night and as he sees the light of a new day he seizes a cup of poison to end his life.

His hand is stayed by the sound of Easter carols sung by passing maidens. It tells of the joy of living.

Then enters Mephistopheles. He offers Faust gold, glory, power—youth, all he has hitherto missed—and with a vision of Marguerita before him, Faust signs the contract—the devil is to serve Faust here—but the relations are to be reversed below in Hades.

Then Faust successfully woos the maiden Marguerita with the aid of Mephistopheles.

But Valentine, Marguerita's brother, returns from war and upon learning of his sister's betrayal attempts to kill Faust, but is mortally wounded in the combat. Marguerita seeks consolation in prayer at the church, but is taunted by the fiend.

The distraught maiden slays her child and is thrown into prison. Faust follows her and implores her to fly with him but Marguerita, seeing his companion, Mephistopheles, falls on her knees and in an agony of remorse implores the pardon of heaven.

The prison walls open, angels of heaven appear and bear the soul of Marguerita with them as they sing their song of redemption—Christ is arisen again.

Three microphones hung in the Mankato armory transmitted the sound waves over 106 miles of wire to the broadcasting station at Minneapolis, whence the music went out onto the air. Another complete telephone circuit kept the operators at the armory in constant touch with the Minneapolis station. Two men were busy at the armory switchboard all through the performance, amplifying here, diminishing there, so that the volume of sound broadcast might be constant throughout.

Lilyan Tashman broadcast from WOR

This is the most pretentious feat of remote control-broadcasting that the Minneapolis station has attempted and Mrs. Poehler, the director, Mr. Sweet, the mechanical superintendent and everyone else were anxious that it be a complete success. Both they and the *Free Press* are grateful to Manager Ferguson and his staff of the Citizens Telephone Company and to Mr. Marshall of the Mankato Storage Battery Company for assistance and materials furnished.

The volume and character of response received was sufficient testimonial to the signal success of broadcasting grand opera.

WLAG is an enterprising broadcast station backed by several live-wire organizations of the Twin Cities. The station is supported by confidence born of civic pride and community spirit. WLAG has performed a real service; thousands of people in the great mid-west have tasted of grand opera.

A few years ago Minneapolis was the gateway to the north—the flux of lumberjacks and Sioux Indians. Music halls were the center of attraction. Radio has been the short-cut from cabarets to "Faust."

* * *

ABOARD the private car "Boston" on its way to the annual Motion Picture Convention in Frisco, was a party that was not experiencing the monotony of long rail travel. Adolph Zukor, of the Famous Players-Lasky Film Corporation, was dean of the delegates from New York. Their private car was equipped with a Radiola Super-Heterodyne set which, according to telegraphic reports filed at the various cities on the route, furnished music and entertainment continuously to the party all the way from New York City.

Another party left New York City in an automobile equipped with radio for the long journey to the Pacific coast.

Travel has become very fast. But apparently not fast enough. By train, by automobile, and probably by airplane in the near future; we will find the agent to greater speed by employing our time *en route*. Radio will very likely concentrate the vast number of things we now find too many for consumption in the few daily hours. We can now absorb a great deal in broadcast reception.

* * *

WILLY LAMPING, one of Europe's greatest musicians and a far-famed master of the violoncello, is a director of the German Violoncello School, founder of the Bruehl Castle Quartet, Kurkoein, artistic conductor of the Rhenish Chambermusik Festi-

vals at Cologne and the castle at Bruehl, and organizer of the International Music Festivals.

Lamping is in America in the interest of the International Chamber Music Association. He included in his tour a musical program broadcast from WIP.

Such festivals have been pretty well confined to music lovers' circles, probably because most of us do not have time to learn something of the history of various musicians. In this case, the announcer furnished a brief outline of the individual. It aroused interest and engaged the respect of an audience largely foreign to concert halls. The recital then had a sympathetic audience much greater than a concert hall could possibly hold.

Strict attention to the announcers' introductions is usually important if we wish to get the most from broadcast programs.

* * *

THE League of American Pen Women is a national organization of woman writers and composers, with chapters in almost every state in the Union. Its national president, Mrs. Louis Geldert of Washington, has appointed state presidents, which in turn have been developing radio affiliations whenever possible. In New York City and Washington, radio broadcasting is being done regularly, and in Kansas City and several other cities, radio chairmen are appointed, but as yet the work has not been constructively regular. Chicago is the first in the west to arrange for a weekly program of the members' work.

Each program, which is given on Tuesday evenings between 8 o'clock and 8:15 from WGN, consists of cuttings from the writings of Illinois literary members, short stories, poetry and reviews of longer books, and musical numbers composed by Illinois members. Visiting league members from time to time address the radio listeners, and the contact with members over the state and in adjoining ones is highly beneficial for furthering creative work within Illinois.

* * *

A FARMER near Wilkensburg, Pa., had been a regular listener to the series of talks broadcast from Pittsburgh on the activities of the Bureau of Animal Industry. One of the talks was on the subject of tuberculosis eradication. His interest thus aroused turned to one of his own cows which had been noticeably unthrifty and affected with a bad cough.

He went to the local office of the Bureau of Animal Industry for advice. The inspector in charge informed the State representative of the case. The State man then made three futile attempts to reach the farm by following the directions which the farmer left. Failing to reach the inquirer in this manner, the farmer was "paged" by radio from station KDKA. It was announced that efforts had been made to reach him and if he were listening in to get in touch again with the office.

Two days later the farmer came to the office. Arrangements were then made to conduct the State representative to the farm for an examination of the suspected animal. The symptoms were suspicious and arrangements were planned for an official test.

HARRY BURLEIGH, leading creative genius of the Negro race in music, both as composer and interpreter, was heard by radio listeners in an exceptional program of negro spirituals when station WJY of the Radio Corporation of America broadcast the anniversary vesper service from Old St. George's Episcopal Church. The service commemorated the 30th anniversary of Harry Burleigh's entrance into the St. George choir, and presented many of Burleigh's spiritual compositions, sung by Mr. Burleigh both unaccompanied and assisted by the full choir and organ of the church.

Only because of the genuineness of Harry Burleigh's musical gift has he been able to attain his remarkable success, for he has had to overcome the apparently insurmountable difficulties of poverty, self-education and the handicap of Negro blood. From the time he was sixteen he sang in church choirs on Sunday, working outside of school hours and during vacation. Not until he was twenty-six was he able to obtain any real musical training, when he obtained a scholarship at the National Conservatory of Music. For four years Burleigh studied under the greatest masters in the country, receiving particular attention and encouragement from Dvorak, the greatest of Bohemian composers. In 1894 he won the position of baritone soloist at St. George's from sixty other applicants, his voice outweighing in the minds of Dr. Rainsford and the vestrymen any objections that could be advanced to the color of his skin.

—W. A. H.

Clef Club Orchestra, broadcast from WOR. This orchestra plays at the Hotel Clarendon in New York City, and is also the "official" orchestra for all Spanish functions of any prominence. They first came into the limelight at a successful Spanish ball following the war. Their ability to inject real melody into any music, including jazz, is the secret of this orchestra's popularity

RADIO NEWS FROM ALL OVER THE WORLD

Hungarian Station

A NEW radio station has been erected at Szekesfehervar, receiving station at Tarnok, which will be open for general public correspondence. Call letters: HAR.

This radio station in co-operation with the old station at Csepel is intended for maintenance and development of radio communication with the European countries.

Both these radio stations, Szekesfehervar and Csepel are operated from the central telegraph bureau at Budapest.

Mexico's Need for Radio Communication

TAMPICO, MEXICO, and its environs have been subject to the troublesome exploits of bandits. The jungle country which spreads between the oil fields and the plain of Tampico offer the bandits a field of activity admirably suited to their purpose. One band in particular has succeeded in evading the rurales for a number of months. Finally it was discovered that the bandits were provided with field telephones which were tapped into the private lines of the oil companies, thus keeping themselves well informed of the dispositions adopted for their capture; and also informed them as to the companies' arrangements for paying their men. The companies tried to overcome the difficulty by sending pay rolls by aeroplane, but the telephone lines gave away the secret. The paymaster was captured before even he had reached the aeroplane. In face of such a situation the government was forced to take action. So the authorities have thought to handicap the operations of bandits by installing wireless.

The last paymaster captured was forced to turn over to the bandits 42,000 pesetas which he was carrying. Of the two Americans accompanying him, one was killed and the other wounded. The Mexican Government proposes to increase the facilities offered to commerce and industry by the existing paucity of telephone lines by organization of a net work of radio stations of the most modern type, covering the whole country. In this country of more than fifteen millions of inhabitants, the establishment of a satisfactory telegraph net work seems to be a tremendous undertaking and evidently a wireless installation is necessary. Forty-two radio stations are planned. Four stations will play the rôle of central stations, having a power of two to four kilowatts. They will work on wavelengths of from 600 to 3000 meters with umbrella antennas comprising two separate sections, one for the longer wavelengths.

Station SPS mounted on top of the Serrath mountains and known as the highest radio station in the world. It is located in Santos, Brazil

Radio World's Fair

THE First Radio World's Fair which is to be held in Madison Square Garden, New York City, Sept. 22nd to 28th, under the auspices of the Radio Manufacturers' Show Association, with U. J. Herrmann as Managing Director and James F. Kerr as General Manager, is attracting universal attention throughout the country. Leading newspapers here and abroad are devoting columns to the coming show.

As nine-tenths of the exhibiting space in Madison Square Garden has already been contracted for and as the remaining ten per cent. is oversubscribed, it is practically a certainty that the exposition will be forced to spread out and take in the 69th Regiment Armory, located just across the street, upon which the R. M. S. A. has just taken an option.

Among the new features to be introduced this season will be a "Foreign Division" in which many of the important radio interests abroad will be represented by carefully selected official exhibits. The European manufacturers and inventors are said to be making elaborate preparations for this their initial invasion of America and they promise to furnish the radioists of this country with a few real surprises.

A special "Board of Radio Authorities," now being chosen with great care, will award suitable prizes to the most meritorious wireless inventions perfected during 1924. The competition will be open to all and no entry fee will be charged. In addition to presenting each successful inventor with a medal, a diploma or cash, the jury of experts will also endeavor to assist each inexperienced successful inventor to market his or her invention to the best possible advantage at no cost. Public demonstrations and tests of the new inventions will be held daily, and many novel devices will probably be brought to light.

Two hours per day will be set aside for the exclusive transaction of business between exhibitors and wholesale buyers. The general public will be admitted at one o'clock every afternoon and the show will remain open until eleven o'clock every night, including Sunday, Sept. 28th, which is the closing day.

The Amateur Builder's Contest, which will be of an international character this year, will be a good sized exhibition in itself. Entries are already coming in from Europe, South America and distant points in this country. Space enough to display several hundred sets has been reserved and twenty-five valuable prizes will be awarded to the winners.

Third National Radio Show

THE Third Annual National Radio Show will be held this year in Grand Central Palace during the week of November 3.

Plans are under way for holding a convention of radio enthusiasts in connection with the annual Radio Week. This convention will embrace members of the trade as well as the army of fans. Celebrated scientists and important figures in the radio industry will participate in this congress.

Austrian Broadcasting

THE demonstrations of broadcasting by the Technological Trade Museum have made radio very popular in Austria. In view of the great economic and social importance of broadcasting, which has created a new industry in Austria, a permanent service has now been undertaken by the Oesterreichische Radio-Verkehrs-Aktiengesellschaft. At present this company co-operates with the Austrian Postal authorities in the matter of transmission.

It is proposed to use the radio installation on the building of the War Ministry for the first broadcasting station. Experiments have already been made with a normal sending power of one kilowatt. Different wave lengths will be used; on March 25, broadcasting took place for the first time on a

S.S. Columbus broadcasting from her Brooklyn pier. This voice was heard upon the arrival of the ship, giving information to the country that the Columbus is the newest ocean liner, arrived in America

1200-meter wave length. On Easter another trial took place and regular broadcasting is to be started on July 1.

It is planned to broadcast general programs comprising musical performances, lectures, fairytales for children (in the evening), weather, market and exchange reports. Economic data, intended for a small clientele, will consist of foreign prices of commodities and stocks, tariff rates, freight rates, and other important economic reports. These reports will be given in code, which will be changed every week so as to avoid listening in by those not entitled to the service.

The tax for a radio set will be 10 gold crowns collected by the federal post offices. To cover the expenses of the broadcasting station, every owner of a radio set will have to pay a yearly fee of possibly 50 gold crowns. This fee will be reduced considerably in cases of hospitals, associations, and schools. Motion picture houses and other public places, where radio is used for advertising purposes, will pay a higher rate.

New General Electric Station

A LARGE experimental radio station will shortly be built by the General Electric Company for a more complete investigation of radio phenomena and broadcasting. It is understood that the cost of the experimental station will be approximately $150,000, and that it will be located on land recently acquired by the company in Schenectady.

It is understood that a power house will be constructed capable of delivering high power at various frequencies, and antenna structures will be erected for a wide range of wave lengths so that systematic investigation can be made of the advantages of various wave lengths in solving the many problems with which radio now has to deal.

The requirements of the present-day broadcasting program, including stock reports at noon, an afternoon program for those at home, evening stock and market quotations, weather reports, musical programs, plays and religious services, have filled up the available time. It has also been found that the space available in the power house and operating section of the big broadcasting station is not sufficient to permit experimental work without interfering with the regular programs. On this account a new station was considered necessary for intensive experimental work.

The broadcasting station now known the world over as WGY was originally built, several years ago, for experimental purposes. Those familiar with the workings of the station know that the regular programs have been broadcast for many months at two wave lengths—the regular wave length of 380 meters available to those using standard receiving outfits and also a lower wave length of 107 meters which has been found particularly well adapted to long distance transmission for rebroadcasting. On several occasions during the early spring, WGY's programs have been rebroadcast by the British Broadcasting Company in London and thus made available to the British Isles as well as to France and other continental countries. This is only one of the many experimental developments to which WGY has contributed.

A. Pawelek, radio engineer of the S.S. Columbus, holding the latest type of apparatus for testing spark gap of wireless transmitting set. Its construction is similar to a miniature crystal radio set. Antenna is enclosed in wood block with crystal detector and headphone plug in base

Spanish Radio Broadcasting

THERE is considerable evidence of the spread of radio interest in Spain. The Radio Society of Spain has in its recent radio concerts done particularly well. Radio fans in England received the speech of the Count of Alba de Yeltes, transmitted in English and in Spanish from the society's station. Radio concerts have been given by the station at Ciudad-Lineal under the direction of D. Antonio Castilla. A selected program of music and song was received by many persons all over Spain, who returned cards to this station announcing the reception of its program.

Scandinavian and German Movies and Broadcasting

COMBINING motion pictures and broadcasting, an interesting experiment is reported from Europe in which the new German radio station at Königswusterhausen broadcast a technical talk which was illustrated by a film run simultaneously in Copenhagen, Gotenburg, Christiania and several German cities. This first attempt at combining broadcasting with illustration by motion picture was made on May 11th. The broadcasting was done on a wave length of 2600 meters. This experiment opens up interesting possibilities.

Trans-Atlantic Radio Telephony Development

FOLLOWING a demonstration in January, 1923, made by the officials of the American Telephone & Telegraph Company and the Radio Corporation of America, in co-operation, radio telephone speech was transmitted for two hours from New York to London, the British Post Office appointed a committee to investigate trans-Atlantic telephony. This committee has recently recommended that the British Post Office establish a 200 k.w. radio telephone plant at their new radio station at Rugby, England. The committee recommends that this plant be of a type similar to that which has been used by the American Telephone and Telegraph Company and the Radio Corporation of America in the experiments which they have been carrying on for the last eighteen months in transmitting speech across the Atlantic.

If this work is carried out, it is the expectation that under favorable atmospheric conditions during the winter months, it will be possible to connect telephone subscribers in the United States to telephone subscribers in London, and in this way permit them to talk to each other as they do over ordinary telephone circuits. In doing this the subscribers at each end would be connected to their respective radio stations by the wire telephone lines.

The British Post Office, to cooperate in this work erected a special form of receiving antenna, and pending the erection of a telephone transmitting station, have been carrying out careful measurements of the energy which they receive under various conditions from the telephone transmitting station in America, and also from certain telegraph stations.

The tests which will be possible when the British transmitting station is completed will form another important step in the work which has been carried on for many years in the development of radio telephony across the Atlantic Ocean. The first successful telephone transmission across the Atlantic was in 1915, when engineers of the American Telephone and Telegraph Company succeeded in talking by radio telephone from the United States Naval Station at Arlington, Virginia, across the Atlantic to Paris, while the same messages were heard 5,000 miles to the westward at Honolulu.

Another step in this work which created much interest took place January 14, 1923, at which time Mr. H. B. Thayer, President of the American Telephone and Telegraph Company, and other officials of that company, talking from their offices at 195 Broadway, New York City, were heard by a group of well-known engineers and others assembled at New Southgate, England. These tests were made possible by cooperation between the American Telephone and Telegraph Company and the Radio Corporation of America. The tests were very successful, the voices being clear and distinct, and easily recognized by the men at the receiving end who were acquainted with the speakers. The circuit remained very constant during the two hours for which speech was transmitted. Reception was carried out a part of the time through loud speaking receivers, and reporters present took down many of the messages verbatim.

The tests which have already been carried out, and the additional tests which will be made when the new British station is erected, will give information as to the practicability of establishing transatlantic telephone service, the best operating methods to be employed, the attitude of the public toward such a service, and many other factors to be determined before the opening of any regular commercial service.

Briefly, the news from London indicates that preparations are well under way for transmission from London to New York, and that when completed two-way talking, at least experimentally, will be possible. It will be remembered that transmission from New York to London was successfully accomplished in January, 1923, the answers from London being telegraphed by cable.

Above: Radio station aboard the S.S. Leviathan showing special duplex receiving apparatus which enables two operators to work simultaneously and independently. Radiograms can be sent to and received from American and European coastal stations, or ships, at the same time.
Below: Radio staff of the S.S. Leviathan (left to right) E. N. Pickerill, chief; Geo. E. Sinclair, 1st asst.; Henry F. Bollendonk, Oscar L. Goertz, Paul W. Karr, Earl F. Whiddon, Leslie Veader, Roy W. Jones, and two messengers. This staff handles a large volume of messages.

Moroccan Broadcasting

A MILITARY station at Tetuan, in northeast Morocco, is giving concerts and talks every afternoon from 5 to 5:50 by means of gramophone.

German Coastal and Ship Stations Rates

THE coast station rate of all German stations, shown in the Official List of Radiotelegraphic Stations open for general public correspondence, will be 30 centimes per word, minimum Fr. 2.40 per radiogram.

Ship tax of all German stations shown in the above mentioned list open for general public correspondence (with the exception of the naval stations, the ship station Hertha DHQ and Odin DOQ) will be 40 centimes per word, minimum Fr. 3.20 per radiogram.

The interior rate will be 15 centimes per word, minimum Fr. 1.20 for ordinary radiograms and 45 centimes per word, minimum Fr. 3.60 for urgent radiograms.

Directional Transmissions to Australia

POSSIBILITY of transmitting radio messages in a "beam" between England and Australia—an airline distance in excess of 8,000 miles—is likely to be demonstrated, according to an announcement in the Australian House of Representatives by Premier Bruce.

The Premier is quoted in a Melbourne despatch as saying the whole position of radio transmission had been radically changed "within the last fortnight."

Senator Marconi, inventor of the wireless, announced development of a system of directional radio transmission early last December. The electric waves carrying the message, he said, could under the new scheme be turned in any desired direction, like the beam of a searchlight, as opposed to the present system whereby the waves are sent out in all directions.

He announced that communication had been successfully carried on by this means between England and St. Vincent, one of the Cape Verde islands, a distance of 2,250 nautical miles. Only a fraction of the electrical energy hitherto found necessary was employed.

Argentine Broadcast Progress

NOT only are Monte Grande and Villa Elisa to be centers for transmission and reception respectively of trans-Atlantic radio telegraph messages, but these particularly favorable sites are to be utilized for the installation of a powerful broadcast receiving and sending station. The receiving station is being installed at Villa Elisa which will be capable of getting North American broadcasting stations. The programs from these stations will then be relayed by cable to Monte Grande, where they will be rebroadcast from an antenna that is being erected close to the larger antenna of the high power station. The studio of the present station whose call letters are LOZ, located in Buenos Aires, will also be connected by cable with this transmitter at Monte Grande. The engineers claim that the installation of this broadcasting station will not interfere with the present transoceanic station. This represents the first commercial installation of broadcasting on a considerable scale.

Two new broadcasting stations of an official character have recently been established in the Argentine—one at the University of La Plata and one of equal power in Mendoza. Both these stations are expected to cover a wide range.

Argentine government radio station, one of the most powerful in South America, located at Buenos Aires in the entrance of the harbor of Darsena Norte

Secret Radio Wave

JOHN HAYS HAMMOND, Jr., the American inventor, has demonstrated to the British Admiralty his latest device in radio transmission. He has entered into a contract with the Italian Government for a number of transmitting and receiving sets of a new system, to be constructed in the United States.

This system permits of secrecy in radio transmission and enables each station to send more than one message simultaneously on the same wave length. Great utility in wartime is claimed for it because it makes use of certain combinations of wave lengths which must be known before a message can be picked up.

Belfast Broadcast Station

IN Belfast, a new broadcast station will be added shortly to the present British Broadcasting Co. installation. This new station will have the call letters 2BE, and will transmit on a wave length of 435 meters.

Danish Wireless Association Formed

AT a recent meeting in Copenhagen, representatives of all the provincial radio clubs resolved to form a national association of such clubs. The general object of the association is to safeguard the interests of radio amateurs. The task of the association is to provide funds for the establishment and operation of a modern and powerful broadcasting station in Denmark.

Radio at the Political Conventions

THE latest developments in radio and the new method of transmitting photographs by telegraph were used to make the proceedings of the Republican National Convention audible and visible to millions of Americans, distant from Cleveland during the period of the convention.

Arrangements were perfect for sending the convention speeches broadcast from radio stations as far west as Kansas City and for amplifying the voices of the speakers so that they could be heard distinctly by every one of the audience.

Extra microphones were installed to prevent any possibility of mishap. In addition to a regular amplifying set which remained permanently in the hall, a duplicate emergency set was installed to be switched on in case there should be any unforeseen accident to the regular apparatus. Among the stations broadcasting the proceedings were: WRC and WCAP, Washington; WEAF and WJZ, New York; WNAC, Boston; WGY, Schenectady; WGR, Buffalo; KDKA, Pittsburgh; WJAX and WTAM, Cleveland; WLW, Cincinnati; WLS and WGM, Chicago; KSD, St. Louis, and WDAF, Kansas City.

A FOUR-TUBE set adapted for Summer use—3 stages of radio frequency amplification, a crystal detector and two stages of audio frequency amplification gives ample distance and volume.

The Wireless Age Portable Reflex

Not So Big, But It Gets the "Sigs"

By Robert Alan

SUMMER is here again and the exodus from the cities has begun. Those who have spent the long winter evenings listening to their favorite broadcasting station, will miss a great deal of pleasure if they depart for the summer months without a radio set in the trunk. Now those who do pack a set along with their blankets and swimming suits are not going to make that set the five-tube neutrodyne or the 10-tube "super" which they have used all winter. What they will take is a nice little portable outfit that really is portable. It's going to be portable in every respect, the antenna, the batteries and the loud speaker.

First of all there is no loop which meets our idea of thorough portability, so we won't use a loop. The set must be much more sensitive than your home outfit because wherever you are, on the yacht, or camping in the mountains or at the shore, the chances are that you are going to be a distance from a broadcasting station. Your portable summer set must be able to bring in the city stations with as much satisfaction as you are accustomed to in the city. In order to do this it must have at least three stages of radio frequency amplification. Considering all things we have decided to adapt the four-tube set described in the April issue of THE WIRELESS AGE for summer use, and make it as portable as is possible. The only way this new set differs from the April set is in the antenna. Instead of using a loop we have incorporated a vario-coupler in its place, so that it can be used with an outside antenna. Now this antenna can be most anything in the shape of a single wire stretched out between two trees, or between your tent pole and a stake driven in the ground about forty feet away. Because of the sensitivity of the set it will be possible to obtain results with a very poor antenna. With the poorest kind of antenna it will still give better results than the loop will. We are going to use a crystal detector because we like crystal detectors in reflex sets, and because it will save us one tube and because we have found a very good one. The set will include three stages of radio frequency amplification, crystal detector and two stages of audio amplification, the first of which is reflexed back to the third radio tube. This set when finished will be possibly six inches deep and twenty-one inches long and can be very easily placed in the suit case or placed in a cabinet with a carrying strap.

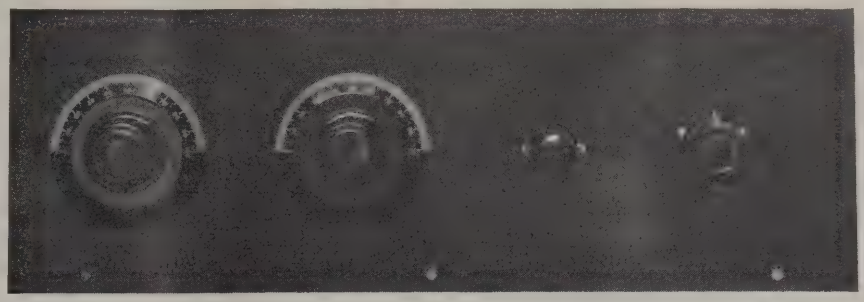
THE PANEL LAY-OUT

In drilling the Formica panels, start with the three holes for the screws which secure the panel to the baseboard. These are placed three-eighths of an inch from the edge of the panel and one centered along its length and one on each end, two inches from the edge. This provides a good stable support for the panel. The vario-coupler is mounted along its extreme left end with its center hole three inches from the left hand edge. The variable condenser, Cardwell .0005, is mounted next with its center hole eight and one-half inches from the left end. Next drill the holes for the Filkostat and General Radio potentiometer. The potentiometer is located three and one-half inches from the right end and the Filkostat seven and one-half inches from the right end. Four-inch dials are used on the tuning instruments because they afford greater ease of adjustment and closer tuning. Assemble the instruments on the panel, then lay it aside and mount the transformers and sockets on the baseboard. The radio frequency transformers are mounted in echelon fashion at a forty-five degree angle with respect to the rear of the baseboard. The tube sockets are mounted between the transformers and flush against the rear of the baseboard. Starting at the left the first socket is centered two inches from the left hand edge. A transformer mounted next, the second socket six and three-quarter inches from the left hand end and so on down. The sockets are four and three-quarter inches between centers. This affords room at the left hand end for mounting the second audio frequency transformer. The first audio frequency transformer is mounted between the potentiometer and the Filkostat up against the rear of the panel. You will find the Filkostat of considerable value in the regulation of these UV-199 tubes which we are going to use and a very critical adjustment can be had. Follow the photographs closely in mounting the

LIST OF MATERIALS

1	.0005 Cardwell variable condenser
1	Paragon vario-coupler
4	Na-Ald UV-199 sockets
3	Acme Radio frequency transformers (R-2) (R-3) (R-4)
2	Acme Audio frequency transformers
1	General Radio Potentiometer 400 ohms
9	Binding posts (Eby)
1	Pacent single circuit phone jack
2	Quinby frames
1	Formica 7" x 21" panel
1	Formica strip 2" x 14"
1	.001 Dub. Micadons
2	.002
8	Lengths bus wire
4	Lengths spaghetti
1	Base board 7" x 20"
1	Foote fixed crystal
1	Marco panel mounting tap switch—7 points
1	Carter jack switch for A battery

instruments as the arrangement represents much experimentation in providing general all around efficiency. This arrangement keeps the grid and plate capacities as low as possible and the radio frequency amplifier as stable as possible. Do not attempt to hook up a radio frequency amplifier with wires running criss-cross. If you do you will cause the amplifier to oscillate beyond the control of the potentiometer. Directly above the Filkostat on the panel will be found the Foote crystal detector. This is an exceptionally good one and will be found to give satisfaction. Thus the output of the third stage of radio frequency amplification is sent right into the crystal detector and the reflex audio transformer. The audio frequency tube of the third radio frequency tube is then sent into the second stage of audio frequency whence it goes into the loud speaker. The first connections to be made after connecting all the instruments are the filament leads. These connections are plainly shown in one of the illustrations. Run one of these leads to the rheostat and from there to the binding post on the sub-panel in the rear of the baseboard. Connect the other lead direct to the other "A" battery binding post. Now before going further connect up your three dry cells to these terminals and place all four tubes in their sockets and make sure that they all light properly. If this is done now it will obviate retracing your filament connections in case of an error later on. Now connect up your transformer leads. If the transformers are mounted correctly, the grid and plate leads will probably be less than one inch long which is what we have been striving for. Be sure not to omit the small fixed condensers shown in the diagram. One of the .002 mfd. fixed condensers is shunted directly across the B battery binding posts on your terminal strip and acts as a bypass condenser around the B battery. The B battery with its long leads and inherent high resistance must have some sort of bypass for the radio frequency currents. The other .002 fixed condenser serves the same purpose with respect to the primary of the second audio frequency transformer. The .001 fixed condenser acts as a by-pass condenser across the primary of the first audio frequency transformer performing the same function as a phone condenser in an ordinary hook-up.



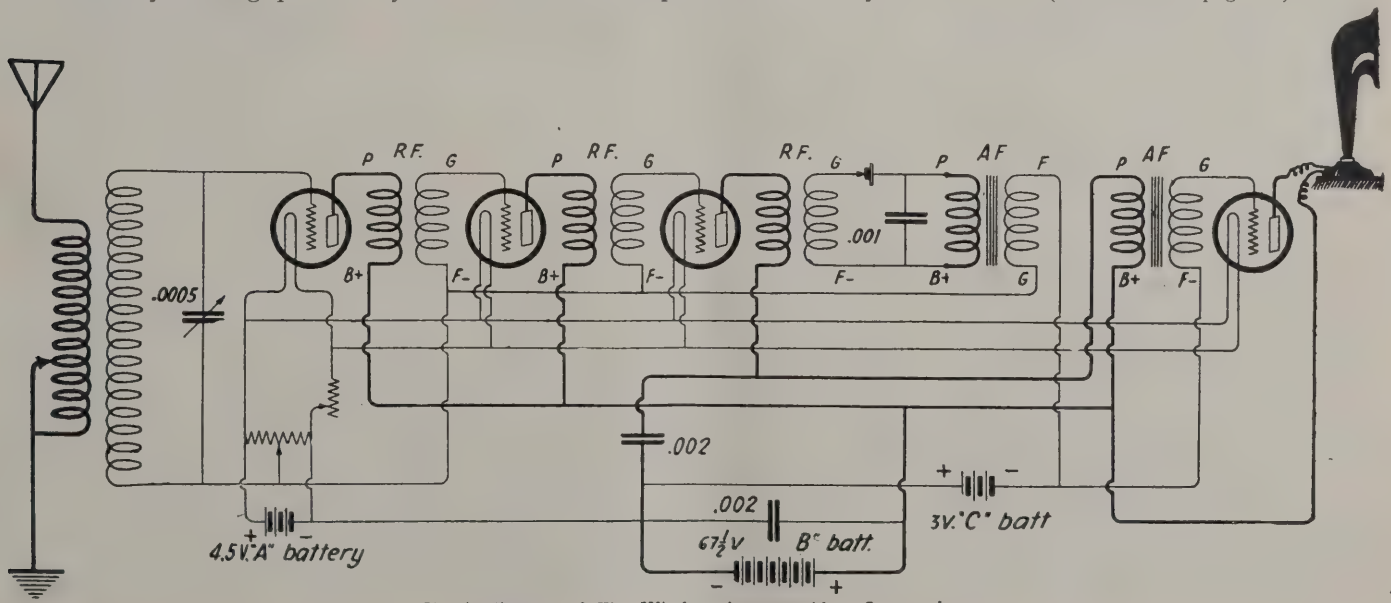
The front panel arrangement is made with a view to economy of space combined with facility in operating the receiver

Connect the variable condenser across the secondary of the vario-coupler and then run leads from the stator plates to the grid of the first radio frequency tube and from the rotor plates to the arm of the potentiometer. There are seven taps on the primary of the vario-coupler which are connected to the panel mounting tap switch shown on the panel. This tap switch is mounted conveniently between the condenser and coupler. Be sure that the condenser plates are connected as stated, for this will eliminate any hand capacity effects—there being no difference in potential between your hand on the dial and the potential of the filament circuit. There is a point on the plate current-grid voltage curve of every tube where that tube will amplify to its greatest extent with a minimum of distortion. If we use sixty-seven volts on the plates of our amplifier tubes we must use a three-volt "C" battery to carry out this condition. This will keep our plate current low and save our "B" battery. The leads from the audio frequency transformer posts marked F minus or A minus are brought to the negative C battery binding posts on the terminal strip mounted on the rear of the baseboard. A connection is then made from the positive C battery binding posts to the negative filament lead.

Your Portable Antenna

About the simplest form of a portable antenna consists of about one hundred and fifty feet of No. 18 bell wire. When you take this out you roll it up on a spool and put the two insulators in your pocket, and you have a good antenna all ready to put up. Fasten one insulator to a tree branch

(*Continued on page* 84)



Circuit diagram of The Wireless Age portable reflex receiver

Condensers

Radio Frequency and the Design of an Efficient Condenser

By Donald Gordon Ward
Associate Member, Institute of Radio Engineers

PART II

IN the first of this series of two articles which was published in the June, 1924, issue of THE WIRELESS AGE attention was called to some of the general requirements which should be met in the construction of condensers and several points which should be specified by the manufacturer. The points which were previously mentioned referred to the maximum and the minimum capacity being marked upon the condenser so that a purchaser will know if the condenser which is offered him is of the proper capacity range to fit with his inductances to give him a circuit of the wave length range which he wishes to have in his receiver.

Another quality of a condenser which is very important to understand is that of the value of the radio frequency resistance that is present in the condenser. In order to thoroughly explain this phenomena and to explain why it is a vital consideration in the design of an efficient condenser it is first necessary to make a few general statements with regards to radio theory.

In a tuned radio frequency circuit the effect of resistance is to broaden the tuning of the circuit and the higher the resistance of the circuit, the greater the extent to which the tuning is broadened. It is therefore highly important, especially in view of the increasing number of broadcasting stations to have a receiver which tunes as sharply as possible. Resistance may be the result of many conditions in a circuit, such as loose joints in the antenna, unsoldered connections, which have become corroded, or resistance in the coils, but we are going to confine ourselves to an exposition of resistance in condensers, with special reference to variable receiving condensers.

One of the first causes of resistance in a variable condenser is in poor contact between the rotary plates and the terminal of the rotary plates. Where the condenser depends for its contact upon a shaft with a conically cut end resting in a concave bearing it will be found that owing to oil having been used when the shaft was turned to size that some of the oil which during the cutting process had been secreted in the pores of the material gradually works out of the pores of the shaft as it is rotated, after the condenser has been put into use and that this layer of oil in the contact offers a very high resistance to the passage of the radio frequency currents. One great disadvantage of this type of connection lies in the fact that this resistance is not always present and that as a result the resistance comes and goes producing a condition that is one of the most difficult to trace. Very often this trouble comes on slowly as the oil is gradually worked out into the bearing and oftentimes it comes so slowly that its action is not appreciated until after it is found that the receiver begins to bring in a lot of interference and that in many cases signals come in and go out with startling abruptness as the condenser is rotated, sometimes accompanied by a slight scratching noise.

Figure 1

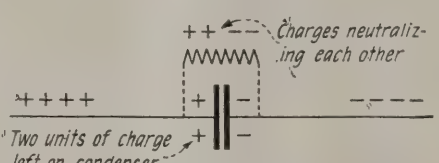


Figure 2

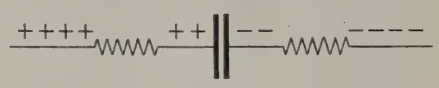


Figure 3

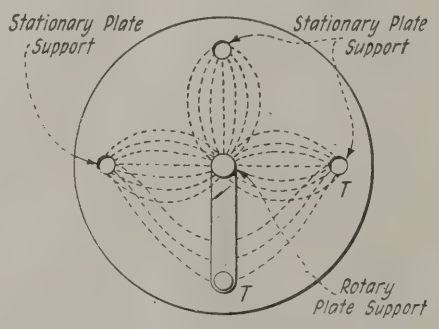


Figure 4

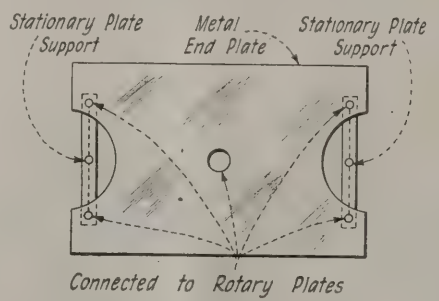


Figure 5

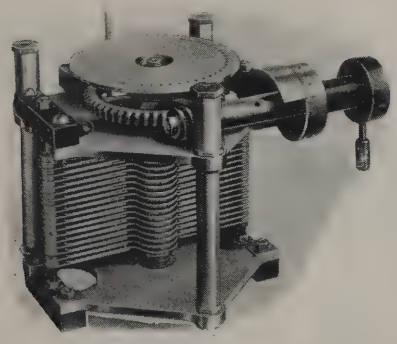
Elements entering into high and low loss condensers

It is therefore advisable when purchasing a variable condenser to pay particular attention to the type of contact that is provided for the rotary plates. This is often corrected by providing the condenser with pigtail connections to the rotary plates and at the same time installing stops upon the condenser so that it may only be rotated one complete revolution as otherwise the pigtails would be gradually twisted off. Another method of making connection to the rotary plates is by means of a contact joint of large surface area. In this case, of course, the very large surface area of the joint will prevent any trouble which might be due to poor contact and in addition when a large joint is employed there is less likelihood of having short circuits develop owing to a poor bearing which allows the plates to move from side to side.

As will be noted, aluminum is the metal which is most commonly employed for plates in a variable condenser with brass a fairly close second. The reason for this is that the radio frequency currents travel only on the surface of the conductor, and therefore the resistance which any material offers to the radio frequency currents lies in its surface. Every metal when exposed to the air gradually becomes oxidized and in some cases this oxide forms very rapidly while in others it takes a considerable length of time for the oxide to form. The metal itself and its oxide very often have radio frequency resistance values which are considerably different. It is therefore advisable to use as a metal for plate construction one which has a radio frequency resistance of the metal closely approaching the radio frequency resistance of the oxide itself or else to use a metal which oxidizes very quickly and has as low as possible a radio frequency resistance of the oxide of the metal. In the case of aluminum the oxide forms almost immediately after cutting and it has as low a radio frequency resistance as it is practicable to obtain in a metal which oxidizes rapidly. There are naturally many grades of aluminum and though the author is not aware of any recently published data on the

radio frequency resistance of different grades of aluminum there is every reason to believe that it differs greatly with the grade of aluminum employed and therefore it is advisable to employ brass in condensers instead of using a grade of aluminum which is any less than the best. These ideas should be taken as general statements and not as specific ones as it must be realized that improvements in the refining of metals are being made daily and if other metals are employed in condensers other than aluminum it is reasonable to suppose that the manufacturer of that condenser has made a study of the adaptability of the various grades of metal. If he has neglected to consider this point he will find that after the man who builds his own commences to demand a statement as to the radio frequency resistance of his product preferably tested by some standardizing laboratory that the demand for that condenser is falling off rapidly and it will be soon found necessary to stop its manufacture.

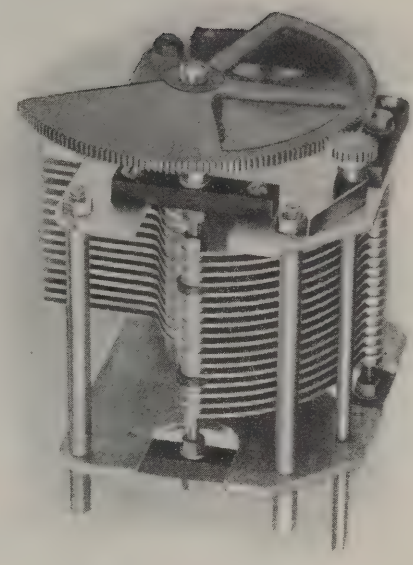
It has been noted lately in several articles on condensers that brass as a metal for the construction of variable condensers has been preferred to aluminum. The reason advanced was that brass could be soldered and aluminum could not and that therefore brass should be preferred, providing that the plates were carefully soldered to the supports. The advisability of this type of condenser manufacture is believed to be open to question as solder offers a very high resistance to radio frequency currents as it contains lead and the radio frequency currents traveling as they do on the surface of the conductor will therefore naturally flow over the surface of the lead and the condenser will have a high resistance and the receiver which uses them will be found to tune rather broadly.



Laboratory type of low loss condenser

The final radio frequency resistance consideration lies in the type of insulation that is used between the rotary and the stationary plates, how much of it there is, and where it is placed. The very best type of insulating material that has been used so far is hard rubber, providing that it is of the very best grade. The one disadvantage of hard rubber lies in the fact that it is not so strong mechanically as some other substances and therefore some manufacturers prefer other compounds which though not so efficient electrically are to be preferred mechanically. Other "insulating" materials many of them of the so-called "Moulded mud" variety are best left alone though no doubt some of the moulded compounds are quite satisfactory, but here again the entire matter would be settled by the manufacturer giving a guaranteed statement of the resistance of his condenser and then if a moulded substance were employed it would have to be of a certain grade or otherwise the demand for that condenser would fall off after the public came to realize that it wanted a condenser with a low resistance in order that the radio receivers would tune sharply.

The method of supporting and insulating the rotary from the stationary plates is an important consideration in the condenser which is designed with a view to low losses. In connection with this a rather amusing experience which the author had a couple of summers ago while on his vacation might be included as an example of what one manufacturer's idea was concerning condensers. (This man's product has since disappeared from the market.) During his vacation in one of the New England States he had occasion to go into a radio store to make one or two minor purchases and the statements given here were overheard as this manufacturer's ideas regarding variable condensers. At the time he was attempting, rather unsuccessfully, to sell his product to the owners of the store. One of the first statements that he made, in reply to a question as to why he did not use aluminum end plates was that his condensers were made with moulded composition because he wanted to put the best into his condensers and that the manufacturers who used milled aluminum end plates did it because it was cheaper. To anyone who is even slightly acquainted with manufacturing process of a mere matter of moulding a substance that can be poured into place as against a carefully and accurately milled aluminum plate this sounds ridiculous in the extreme. Another statement was to the effect that as this moulded insulation was a better insulator than aluminum, which I think everyone admits, it were better to use this insulation in large amounts than be economical with it as is the case in the metal end plate condensers. The point is that the more sparing a manufacturer is with his insulating material the better will be his product.



Commercial type of low loss condenser

The condenser is a device that is used to store up electrical energy in the form of electrostatic lines of force and we want to be sure that it stores them all up and that none of them are permitted to leak away as in the latter case our condenser loses in efficiency. This action results in two charges being stored up on the plates of the condenser as per figure 1. We will say that the charge on one set of plates is positive in character and the other is negative in character. The natural tendency of these two charges is of attraction and if all of the charge on the positively charged plate can pass over to the negatively charged plate the result is that the electrostatic lines of force have disappeared and when we want to use this energy to operate our detector tube it is no longer there.

One of the most important of these resistances is in matter of fact a lack of resistance between the plates thus permitting our energy to pass from one plate to the other in the form of a leakage of current. For example let us suppose that we have as illustrated in figure 1 four units of charge. In this case let us use a perfect insulating material. The four units are then held in the condenser in the form of electrostatic energy and are available for use in our detector a minute fraction of a second later when we want to use them. Now let us suppose as per figure 2 we have such a leakage path between the plates of the condenser, presumably caused by a poor dielectric or insulating medium, or the insulation in the wrong place, etc., that two of these units pass through the insulation and cancel two of the negative units on the opposite plate, then when we come to use the

(*Continued on page 92*)

Antennas and Grounds

Regulations for the Proper Installation of Lead-in Conductors, Ground Switches, Fuses and All Wiring—The National Electric Code for Radio Receivers

ANTENNA and counterpoise outside buildings shall be kept well away from all electric light or power wires of any circuit of more than 600 volts, and from railway, trolley or feeder wires, so as to avoid the possibility of contact between the antenna or counterpoise and such wires under accidental conditions.

Antenna and counterpoise where placed in proximity to electric light or power wires of less than 600 volts, or signal wires, shall be constructed and installed in a strong and durable manner, and shall be so located and provided with suitable clearances as to prevent accidental contact with such wires by sagging or swinging.

Splices and joints in the antenna span shall be soldered unless made with approved splicing devices.

The preceding paragraphs shall not apply to light and power circuits used as receiving antenna, but the devices used to connect the light and power wires to radio receiving sets shall be of approved type.

Lead-in Conductors

Lead-in conductors shall be of copper, approved copper-clad steel or other metal which will not corrode excessively, and in no case shall they be smaller than No. 14, except that bronze or copper-clad steel not less than No. 17 may be used.

Lead-in conductors on the outside of buildings shall not come nearer than 4 inches to electric light and power wires unless separated therefrom by a continuous and firmly fixed non-conductor which will maintain permanent separation. The non-conductor shall be in addition to any insulating covering on the wire.

Lead-in conductors shall enter the building through a non-combustible, non-absorptive insulating bushing slanting upward toward the inside.

Each lead-in conductor shall be provided with an approved protective device (lightning arrester) which will operate at a voltage of 500 volts or less, properly connected and located either inside the building at some point between the entrance and the set which is convenient to a ground, or outside the building as near as practicable to the point of entrance. The protector shall not be placed in the immediate vicinity of easily ignitible stuff, or where exposed to inflammable gases or dust or flyings of combustible materials.

Antenna Grounding Switch

If an antenna grounding switch is employed, it shall in its closed position form a shunt around the protective device. Such a switch shall not be used as a substitute for the protective device.

It is recommended that an antenna grounding switch be employed, and that in addition a switch rated at not less than 30 amperes, 250 volts, be located between the lead-in conductor and the receiver set.

Fuses

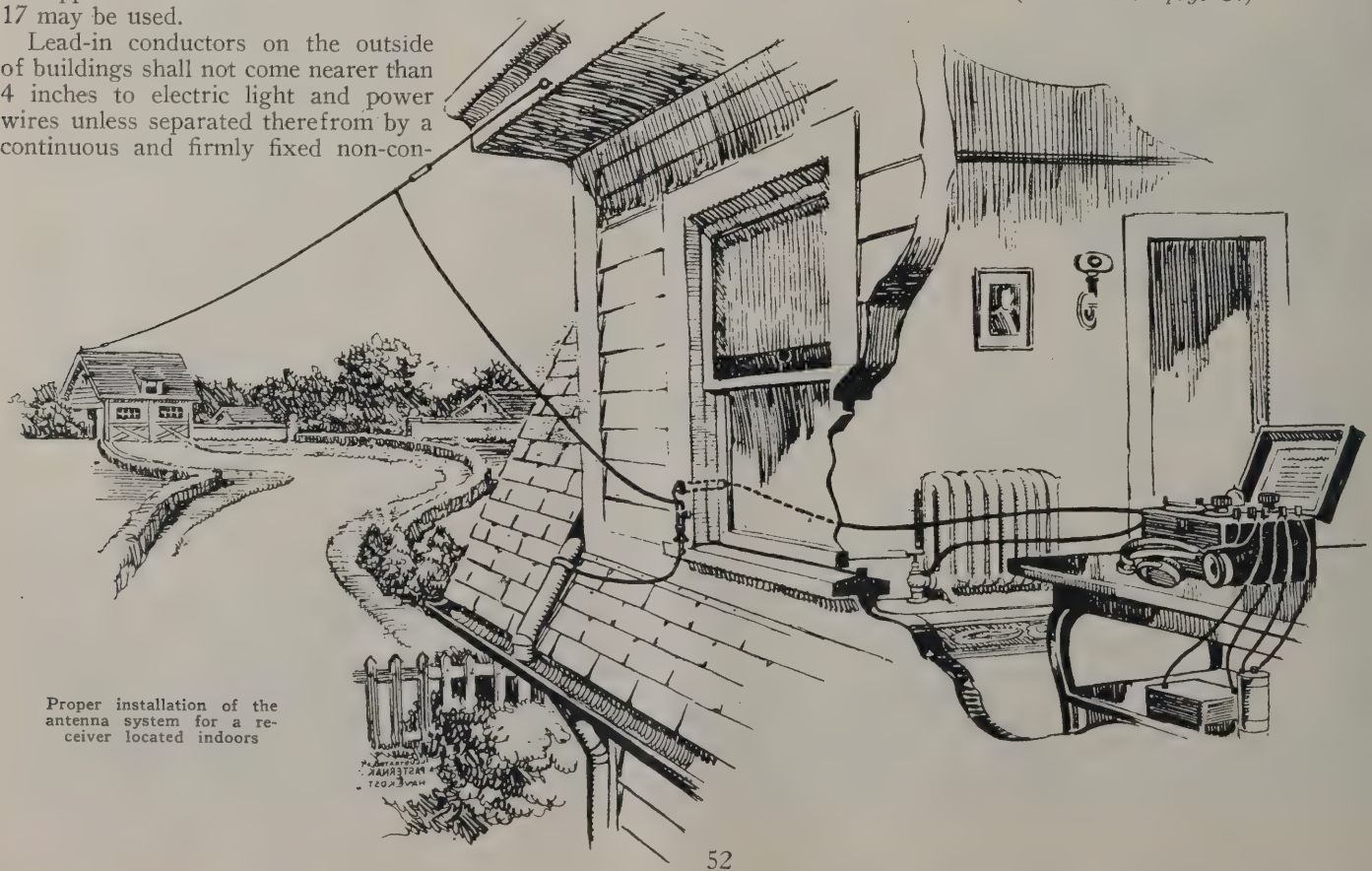
If fuses are used, they shall not be placed in the circuit from the antenna through the protective device to ground. Fuses are not required.

Grounds

The protective grounding conductor may be bare and shall be of copper, bronze or approved copper-clad steel. The grounding conductor shall be not smaller than the lead-in conductor and in no case shall be smaller than No. 14 if copper nor smaller than No. 17 if of bronze or copper-clad steel. The grounding conductor shall be run in as straight a line as possible from the protective device to a good permanent ground. Preference shall be given to water piping. Other permissible grounds are grounded steel frame of buildings or other grounded metal work in the building, and artificial grounds such as driven pipes, rods, plates, cones, etc. Gas piping shall not be used for the ground.

The protective grounding conductor shall be guarded where exposed to mechanical injury. An approved ground clamp shall be used when grounding conductor is connected to pipes or piping.

(*Continued on page* 84)



Proper installation of the antenna system for a receiver located indoors

Radio Aids Sociability in the Home

Mr. Van Blaricom Disguises His Loud Speakers as a Lamp and a Fruit Bowl
A Prize Winner in "The Wireless Age Radio in the Home Picture Contest"

Radio for Veterans in Hospitals

General Frank T. Hines, Director of the United States Veterans Bureau Is Arranging Complete Radio Installation for the Disabled Veterans

By Charles W. Swan

"RADIO brings a new form of remedy to disabled veterans of the World War," declared General Frank T. Hines, Director of the United States Veterans Bureau, recently, in discussing the effect of radio on the sick and disabled ex-service men in the Veterans Bureau hospitals.

"The minds as well as the bodies of our disabled soldiers must be made well and the great growth of the radio industry provides entertainment and education that heretofore has been denied. It must be remembered that many of our patients are bed-ridden. Others are suffering from tuberculosis and still more are afflicted with nervous and mental disabilities. Radio is a means of entertainment for these shell-torn veterans which will take their minds from their afflictions. The educational lectures which form a great part of many of the radio broadcasting programs are enlightening and serve as a medium of keeping the bed-ridden patient in touch with the doings of the outer world."

Orders have recently been issued by General Hines which will provide each of the U. S. Veterans Hospitals with complete radio equipment. This is in keeping with the established procedure of providing every possible assistance to enable the veterans of the World War to regain their former health.

The general plans for the installation of radio equipment call for one master set located in a central point of a hospital. This master set, preferably a neutrodyne or super-heterodyne receiver, will be under the direct supervision of the medical officer in charge and operated by employees of the hospital. Leads will be run from the master set which will also be provided with suitable amplification for the various wards and assembly rooms where loud speakers will be located. For the bed-ridden patients, the plans call for leads to be run parallel with their beds and phone plugs and connections with head sets at each of the beds. These sets will be able to receive programs broadcast from a minimum distance of 1,000 miles.

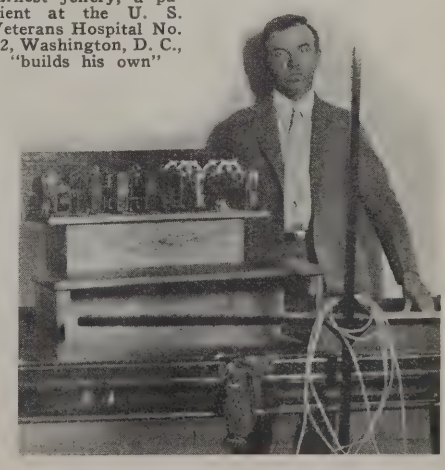
At the present time some thirty-seven of the U. S. Veterans Hospitals have been equipped, many by private agencies, and it is expected that the remaining institutions will have their equipment installed by July 1st of this year.

The plans for the installation of radio equipment in the U. S. Veterans Hospitals are necessarily varied and conform to the type of hospital and the class of patients in the hospital. Loud speakers will be installed in many wards of various hospitals while in others, particularly the institutions caring for tuberculosis patients who are bed-ridden, head sets will be provided with bedside terminals.

"I found many radio sets in quite a few of the hospitals during my inspection trips," declared General Hines, "and many of these were made by the patients themselves. At Mt. Alto Hospital in Washington, there are many types of radio receiving sets ranging all the way from the small crystal receiver to a huge super-heterodyne which is being completed by one of the patients at the present time. Radio has brought entertainment to these men in our hospitals who need diversion and I expect very shortly to have all of our hospitals with complete equipment to care for the veterans' needs.

"I feel sure that the installation of radio sets will be a boon not only to bed-ridden patients, but to all of the disabled men in the hospitals."

Ernest Jeffery, a patient at the U. S. Veterans Hospital No. 32, Washington, D. C., "builds his own"



Continuing a Summary of the Entire Subject of Amplifiers

Amplifiers

A complete review of the principles of correct design

By Louis Frank

PART III

Transformer Coupled Amplifiers

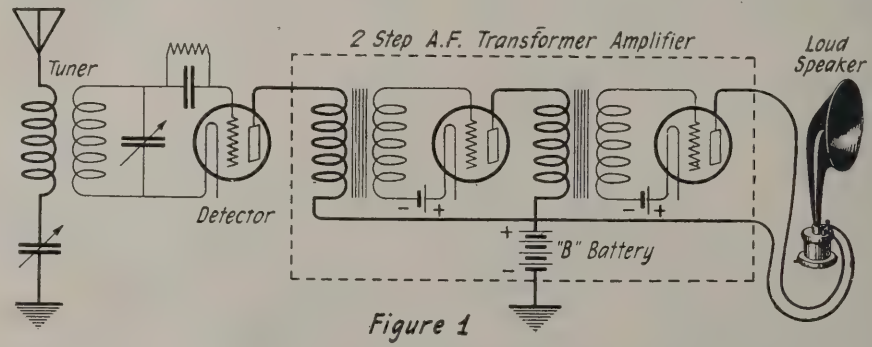
Part I appeared in the May issue and treated single stage amplifiers; resistance and inductance amplifiers, tuned circuit amplifiers and tuned radio frequency. Part II in the June number continued this subject with multi-stage amplifiers; resistance coupled, impedance coupled, audio and radio frequency and choke coils.

IN our treatment of the subject of amplifiers we now come to the final type of amplifier, the transformer coupled amplifiers. The transformer coupled amplifier has one great virtue over all other types, namely it gives more amplification for your money. With properly designed circuits the transformer coupled stage will give from three to five times as much as any other type of amplifier. The reason for this will be seen from the following.

Audio Frequency Amplifiers

Figure 1 illustrates the circuit diagram for a two-stage audio frequency amplifier. Each stage is coupled to the following one by means of an audio frequency amplifying transformer. In such an amplifier there are really two amplifying processes taking place in each stage. In the first place the signal is amplified by the audio frequency transformer because the voltage is stepped up in the secondary. A transformer having a ratio of three to one raises the signal three times, while one with a ratio of four to one raises the signal four times. In the second place amplification takes place in the tube itself, just as it takes place in the other amplifiers previously described in THE WIRELESS AGE. It is the added amplification of the transformer which makes this type of amplifier superior to all others. Now the amplification of the tube itself inevitably takes place if the tube has no defects. But unless the transformer is properly built, not only may amplification not take place in the transformer, but if it is not properly fitted to the tube the amplification of the tube itself may be destroyed.

Most transformers as built today give quite good amplification characteristics. This is because they are built to match the properties of standard vacuum tubes such as the UV-201A and UV-199 tubes. For maximum amplification to be obtained from the tube it is necessary that the transformer inductance be very great as compared with the tube resistance and the transformers marketed meet with this requirement to a considerable extent.



Circuit diagram of a two-step audio frequency amplifier

If the builder of a receiving set buys one of the standard, well-advertised makes of transformer he will secure satisfactory results. It is not recommended that he try to build the transformer himself, as there are so many factors to take into account that it is not likely a home-made transformer will prove very successful.

But assuming that the transformers are secured, what makes for success or failure in an audio frequency amplifier are the small details. First there is the manner of connecting the secondary of the transformer to the grid circuit of the tube. The correct way to connect it is as shown in figure 2, the outside turn being connected to the grid, the inside turn which is nearest the core of the transformer to the filament side of the tube. It will help to understand why. The grid element of the tube is the most sensitive of all parts of the tube. Nothing should be connected to it which would produce any extraneous effects other than those desired or required. Now if a capacity is connected to the grid side of the tube some of the speech currents will be shunted or by-passed through the capacity to the loss and detriment of the amplifier. Now the turns of the secondary winding of the transformer which are nearest the iron core have a greater capacity to earth than the turns which are on the outside of the winding. Thus the inside turns should be kept as far from the grid as possible. This requires connecting the outside terminal of the secondary to the grid. While transformers are not marked this way it is very easy to tell which terminal is the outer terminal by simply examining the transformer and noting which terminal comes from inside the winding and which from the outside. This precaution in connecting transformers is really quite important and determines to a considerable extent the tone and loudness of the signal. A similar precaution holds for the connection of the primary winding. The terminal nearest the transformer core, namely, the inside terminal, should be connected to the plus side of the plate battery, and the terminal farthest from the core, namely, the outside terminal of the primary, should be connected to the plate. These proper connections are shown in full detail in figure 2.

C Battery Voltage

We now come to an important detail which is very largely overlooked by broadcast listeners building their own, namely, the use of a negative "C" battery on the grid of the audio frequency amplifiers. This is absolutely necessary if the quality of speech and music received is to be good. It is best to accept this statement as gospel truth and build on that basis. For those readers who are skeptical and like to know the why and wherefore, figure 3 shows the reason. This figure gives a

characteristic curve of the vacuum tube, and the curve simply shows the response of the tube for different values of grid voltages. When a speech voltage is applied to the grid of a tube it swings equal distances on either side of the average grid voltage. Thus figure 3 (a) shows an alternating speech voltage applied to the grid when the grid voltage is zero. But the response of the tube or plate current does not swing equal distances on either side of the average plate current, because the characteristic curve is really curved in the neighborhood of zero grid volts, as shown by the heavy part of the curve. This unequal response of the tube for equal voltages on either side of the zero grid voltage mark results in distortions and very poor quality. Suppose, however, that we put a negative voltage on the grid of 4½ volts and now apply our speech voltage to the grid. The situation now has the appearance shown in figure 3 (b). This time the response of the tube, or plate current, varies equally on both sides of the average plate current when a speech voltage is applied. The reason is that we are working on the straight line portion of the characteristic curve where maximum amplification and distortionless amplification are secured. The exact value of negative grid voltage to use depends upon the plate voltage used and the tube manufacturers generally state these values. A safe value for almost all audio frequency amplifiers is about 4½ volts negative.

There is yet another advantage, and an important one, to be gained by using a negative voltage on the grid. The life of the plate battery is thereby increased two to three times. Figure 3 shows that the plate current at zero grid voltage is much greater than when the grid voltage is negative. The more negative the grid voltage the less the plate current. The greater the plate current, however, the sooner is the plate battery used up, resulting in increased maintenance. Hence by using a negative grid voltage on the amplifier tube the added advantage is secured of increasing the life of the plate battery considerably.

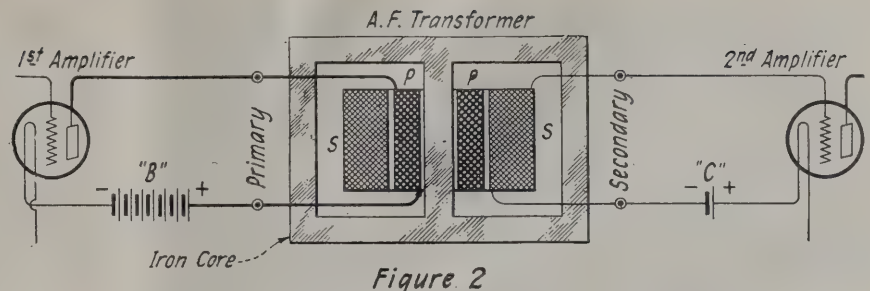


Figure 2

Diagram illustrating the proper connections of the A. F. transformer

The use of transformer coupled amplifiers enables the maximum effect to be secured from the plate battery. For the amplification increases as the effective voltage on the plate increases. Inasmuch as the resistance of the primary winding is relatively small compared to the resistance of the tube practically the entire voltage of the plate battery is effectively applied to the plate, hence the maximum amplification possible with the given plate voltage is secured.

Limit to Two Stages

While it is entirely possible to use three or four stages of resistance coupled amplifiers without much or any difficulty it is not possible to do this stunt with the transformer coupled audio amplifier. In the first place when the amplification is made very great there is a tendency on the part of transformer coupled amplifiers to howl; that is, they generate audible signals which interfere with reception and produce distortion. In the next place other tube noises are introduced which also interfere with reception. There are always present certain irregularities in tube operation, as for example irregularities in the filament, which become evident as a change in plate current, which ultimately causes a noise or signal in the telephones. These changes are very minute and are not very noticeable when the amplification is kept below a certain point. As the amplification increases these noises become more and more evident. It is therefore not recommended that more than two stages of audio frequency transformer coupled amplification be used. This number is the equal of three or four stages of resistance or reactance coupled amplification and is quite sufficient to give good loud speaker operation.

Unless the best type of transformer is used distortion is very likely to result. Transformers do not respond equally well to all the frequencies in speech and music. They may exaggerate some frequencies or diminish others in varying proportions. Hence the signal output may be very much different from the signal input into the amplifier. No advantage is therefore gained in the long run by buying transformers whose only virtue is cheapness. The best audio frequency transformer when it comes to the reception of speech and music is none too good.

In conclusion it would be desirable to make a brief comparison of the three types of audio frequency amplifiers, namely, the resistance, reactance and transformer coupled types. The resistance coupled amplifier is, without doubt, the best from the point of view of quality of reproduction. When properly built it is distortion free. However, it gives the least amplification of all three types, hence will require more tubes for the same signal strength than the others. The reactance coupled amplifier, if properly built, also can give practically distortionless quality, but generally it will be found that the resistance is superior to it. As between the two the resistance coupling is best. The transformer coupled amplifier, though not up to the standard of the resistance coupled amplifier as far as quality goes, nevertheless gives quite good reproduction. It has the advantages of giving the maximum amount of amplification per tube, and therefore requiring the least amount of apparatus. For those who are extremely fastidious or desire to make speech comparisons the resistance coupled amplifier will commend itself. For good all-around results the transformer coupled amplifier is without comparison.

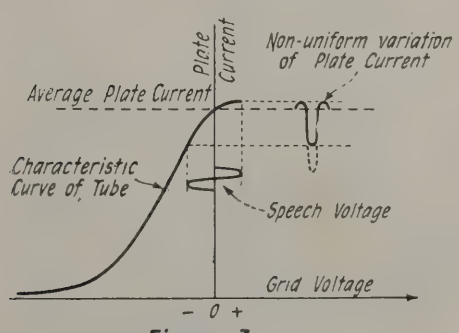


Figure 3a

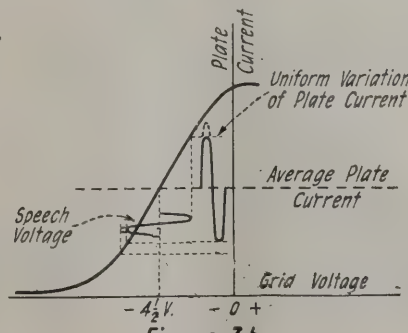
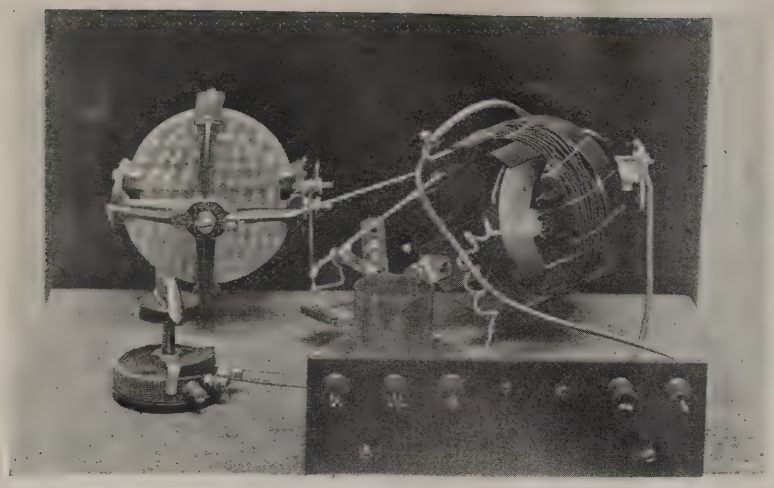


Figure 3b

Graphic curves illustrating the action of vacuum tubes under different values of grid voltage



THIS tuner constitutes a somewhat new development along receiver lines and has shown its efficiency in the results obtained. The station of the well known French amateur Leon Deloy, call letter f-8AB has been copied with excellent audibility without any amplification attached. Stations KDKA and WGY were received on their low wave lengths with sufficient signal strength to operate a loud speaker in New York.

We attribute the excellent results entirely to the construction and apparatus used.

A Low Loss, Short Wave Tuner

Reception on the 100-meter wave is better than on the broadcasting bands. Three powerful stations are transmitting on short waves already, and others will probably do so. It is a simple matter to make a receiver to get this super-broadcasting

By R. A. Bradley

TO begin with we are going to brag about this tuner. It really has delivered the goods and we are rather proud of it despite the fact that we have not tacked our name on it or informed the world that we have discovered something new and that the circuit employed is as old as the hills. In the May issue of THE WIRELESS AGE we presented Mr. Bourne's article on a short wave tuner, originally designed to cover the wave length range of 80 to 225 meters, with several modifications that made it possible to be used for the broadcasting wave band. The discovery of a new variable condenser led us to believe that we could improve upon Mr. Bourne's tuner, which in itself is quite an assumption since Mr. Bourne's tuner was exceptionally well designed.

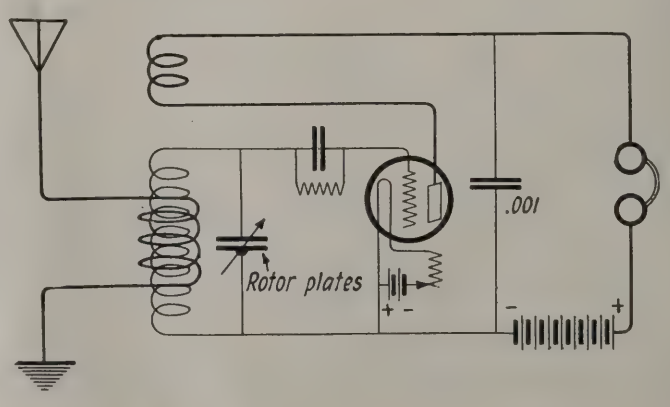
Another addition to 100-meter broadcasting stations has lately been made. At present KDKA at East Pittsburgh, Pa., WGY at Schenectady, N. Y., and KFKX at Hastings, Nebraska, have inaugurated the ultra low wave broadcasting by retransmitting their higher wave programs through a specially built low wave transmitter. Up to a year ago little was known of the regions below 150 meters and due to the difficulties in making transmitters oscillate at this low wave and due to the lack of apparatus that would work efficiently at such very high frequencies, not much work was carried on until recently. A few months ago QST, the official organ of the American Radio Relay League, came out with four or five low wave low loss tuners. Since that time a great deal of interest has been shown by the amateur field in the general downward trend.

For various economic reasons this country has paid more attention to perfecting transmitters than it has receivers. This is probably due to a large extent to the very liberal regulations which our Department of Commerce has given us. In England and France conditions are quite the reverse. They have been very closely restricted in transmission of radio signals and in some countries there is no amateur experimental work carried on in the transmitting field. As a direct result they have specialized in receivers and have developed them to a high degree of efficiency. It is a very common occurrence in the British Isles to hear Pittsburgh, Schenectady and Troy on a detector with one stage of radio frequency amplification on ahead of it. While in this country we venture to say that the London station, 2LO, has not been heard by more than a dozen people in the whole United States with its army of broadcast listeners. So it is apparent that we have much to learn in the receiving line.

Some of us have just awakened to the fact that it is possible to build a better receiver by the incorporation of low loss tuners and low loss variable condensers. So when we ran across the "Bruno" ultra-vario condenser we decided to make a good tuner to go with it.

Realizing the difficulty in the spider-web method of winding coils, we endeavored to discover some means of securing practically the same results with apparatus which the experimenter and home builder had at hand. The circuit shown in the accompanying diagram is the ordinary tuned secon-

The circuit used is shown here—an ordinary tickler feedback with an untuned inductively coupled primary—not an "aperiodic" primary. We haven't discovered how to make one of those yet. It may be to advantage to connect the positive filament to ground in order to prevent the slightest body capacity in tuning. However, we found it unnecessary in this set



dary tickler feed back with the addition of an untuned primary. For the tuning unit an old variocoupler was used. After removing the windings which were on the variocoupler, the circumference of the stator coil was divided into 21 segments. The form was then slotted at these markings with a hack-saw and the alternate segments cut out. The stator coil was approximately three inches long and the slots were made two and one-half inches deep. The rotor coil was slotted and treated in a similar form. A half-inch at the bottom of the coil was left to give strength to the form. A pound of No. 16 double cotton covered wire was then secured and the winding started. Two stator coils were made up in this fashion. The one was wound in a straight ordinary fashion and the other was wound in and out of alternate segments in a spider-web star shaped winding. The advantage of the first was a minimum of dielectric in the magnetic fields of the windings and the advantage of the latter was the lower distributed capacity. The former method was easier to wind and proved quite as satisfactory as the more complicated method of winding. The primary coil consisted of six turns on the end of the coil nearest to the panel. To the end of the six turns a tap is taken off which later goes to the ground and filament side of the circuit as shown in the accompanying diagram. The winding is continued with 15 more turns which form the secondary coil. The end of this winding then goes to the grid condenser. This keeps the high potential part of the tuner as far away from the hand of the operator as possible.

Now we will have to tell you some more about the variable condenser. One of its good features is that it actually covers the capacity range which its manufacturers claim—from .0005, or .00025, or .000125 maximum to .000006 mfd., which is going down some. Did you get the "or" in the last sentence? Well, that is the prize feature in this condenser. That word "or" means that either the capacity of a 23-plate, 11-plate, or 7-plate variable condenser may be had at any time by cutting in or out half of the stationary plates. This means that when you get down to wave lengths below 100 meters where a degree on the condenser means a tremendous change in frequency, you may, by turning a switch employ the whole 180 degrees of the dial in tuning from 75 to 120 meters. If you have had any experience with a short wave tuner the value of this will be readily seen. Tuning on these extremely low wave lengths is an art, and unless you have an excellent vernier on your variable condenser, or unless you use this type of condenser you will probably pass over the station without knowing it.

The panel layout shows but two controls and the phone jack. This keeps all high potential leads and parts of instruments as far away from the hands as possible. It also simplifies adjustment. The rheostat, once set, does not need to be moved nor is a vernier necessary on it

After going to the trouble of securing a really good tuning unit, don't spoil it all by using a paper grid condenser and a "guess-at-it" grid leak. In the fixed condensers use only ones that are mica insulated and know that you are getting the best. Porcelain sockets are to be recommended in connection with this set, and for lowest losses at these high frequencies they should be used. Do not bring the battery and aerial and ground leads out to the front of the panel to binding posts, but mount the posts on a small sub-panel in the rear of the set. This keeps them away from the hands of the person operating the set, and keeps low any hand capacity effects. And one thing more, remember that any old kind of a variable condenser will not make this set function.

Super-Ducon

New Device for Utilizing Electric Light Current

AN invention by Harry W. Houck, the radio inventor who was associated with Major E. H. Armstrong during the World War and worked out with the latter the "Second Harmonic" principle now employed in the superheterodyne, brings nearer the realization of a very general hope to obviate the necessity for batteries in connection with radio receiving sets. This invention, which is termed the "super-ducon," consists, according to report, of a transformer to step down the voltage of the alternating current house electric supply, with Fleming valves as rectifiers and a filter system of iron core choke coils and high capacity condensers.

It will only be necessary for the radio fan to plug in to the electric light line and receive immediately the power for the operation of his set.

Mr. Dubilier (left), radio manufacturer, and Harry W. Houck (right), radio inventor, with the original and the perfected models of the super-ducon, the new device which is designed to replace the batteries used in the operation of radio receivers

Workshop & Laboratory

A New Type Coupler

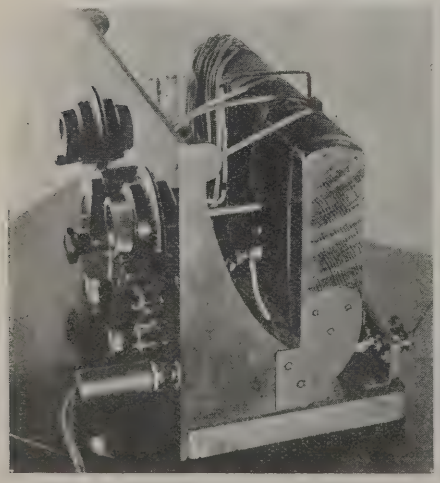
By Ernest H. Reynolds

A PATENT has just been granted on a coupler or tuner, the design and functioning of which are somewhat out of the ordinary. Spark or code interference is eliminated and local broadcasting stations are tuned out to a marked degree for the reception of distant points. Tuning in general on all wavelengths is very sharp. The construction in general of this coupler follows absolutely new lines, there being a rectangular frame, flat sided and hollow in the center. In this center is pivoted a ring-shaped secondary. The windings of this secondary are placed in spiral formation around the ring. The ring in turn is mounted on a divided shaft, the two ends of winding thus connected to shaft. This core rotates inside the primary winding. Around the rectangular framework is wound the primary.

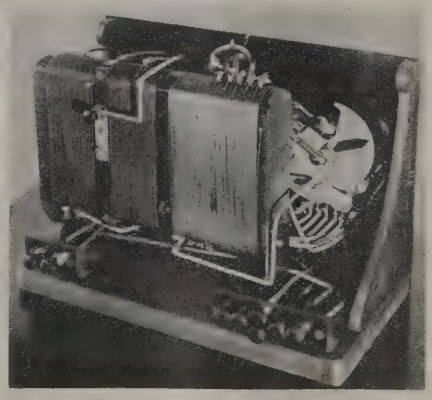
The method in which this coupler is used is quite similar to that followed with other types of variable inductances, namely, that the number of turns of primary, the angular position of the secondary, and the capacity in circuit therewith are mutually adjusted until a condition of resonance exists in the secondary circuit which corresponds to the wavelengths of the signals sought to be received. The apparent advantages of the coupler seem to be the close relation of the primary and secondary which produces induced currents of greater strength and the fact that the adjustment follows approximately a linear law rather than a sine curve which causes the adjustment ratio to be substantially uniform throughout the entire range of adjustment of the secondary. As a result of these two conditions the tuning becomes very accurate and enables the selective reception of signals which vary by comparatively narrow wavelengths and also the elimination of wireless and other interferences to a high degree.

LOUD SPEAKER RESULTS.

Many fans have used a Baldwin Receiver in the bottom of some type of horn for loud speaker results. A drop or two of shellac on the pin in the center of the mica diaphragm, as shown in this picture, will prevent the rattle and resultant distortion frequently encountered.



All windings on the coupler are No. 22 single silk. The frame and rotor are of soft wood, hard rubber being used wherever possible



Mounting Meters

THE ease with which the state of charge of the filament battery may be determined with a voltmeter rather than through use of a messy hydrometer syringe has led many amateurs to install voltmeters on the panel of their receiving sets.

The majority of these measuring instruments are of the "panel mounting" type: i. e., a large hole has to be drilled into which the body of the meter fits, leaving only a thin flange on the surface of the panel.

However, these flanges are rather large, being between 2 and 3 inches, so that often this method of mounting destroys the symmetry of the panel layout.

A much better method of mounting panel meters is suggested in the sketch. Here a hole, identical with the observation window in the meter, is cut from the panel—the meter is then mounted entirely behind the panel.

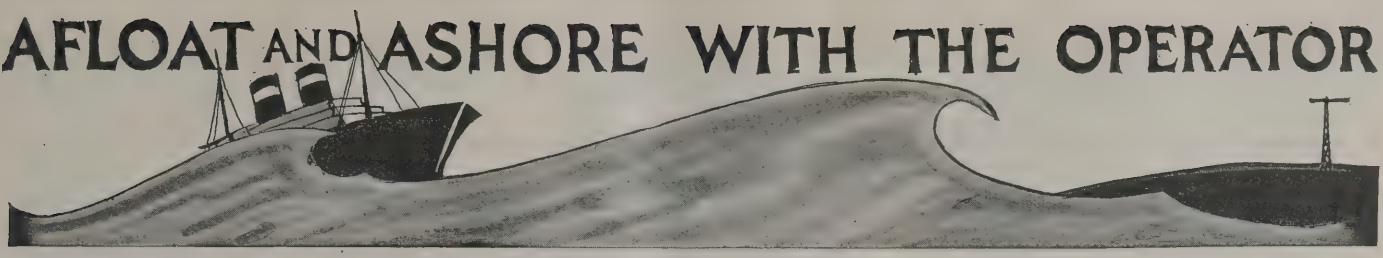
The hole may be cut by drilling a close series of small holes along a scratch outline. The center section may be knocked out and a half or quarter round file used to straighten the edge.

Incidentally in the use of meters for this purpose, one should take a reading only when the battery has been under normal load for at least five or ten minutes.

Battery manufacturers will gladly give a list of average voltage readings for all battery conditions.

Meter mounted behind the panel

AFLOAT AND ASHORE WITH THE OPERATOR



By W. S. Fitzpatrick

"WE read the honor roll of wireless operators, and thrill to their exploits in guarding ocean travel. Their record of distinguished service stands through the years unmarred by failure of men or equipment."

Thus a writer expresses in different words that old unbroken tradition familiar to us all: "Wireless men never fail."

Many are the men who have gone down with their ships in upholding this tradition. To them is due the greatest mark of honor and respect.

While contemplating the bravery of these men who have passed from our ranks we should not forget, however, the many who performed similar heroic deeds though they did not lose their lives. These men merit applause, and to present a few of the names and deeds of such heroes is our present purpose. They are still radio men and might be called upon at any time to repeat, even at the sacrifice of life.

* * *

OTTO E. CURTIS, operator on the *S.S. Sugillenco,* was copying press on the *Kershaw* at 10:30 p. m., March 12, 1918, when with a terrific jolt the vessel went ashore at Montauk Point. The transmitter was so badly shaken that it was necessary for the other operator, Muldoon, to hold the coupling handle while Curtis sent SOS. When a response was obtained he tied the coupler with rope and continued his watch steadily for nineteen hours, during which he was able to bring two coast guard cutters which, upon arrival transferred the passengers to safety.

After his trying ordeal Curtis lay down for a much needed sleep which was broken a couple of hours later by a cry of "Get up quick" from Muldoon. Jumping out of his bunk Curtis landed in eight inches of water.

A few minutes later a wave about fifteen feet high flooded the radio cabin, knocked Muldoon to the floor and left enough water in the place to put the apparatus out of commission. It was necessary to drain the water from the room, wipe the salt from the set and rub it with vaseline to dry. Just as they had the set in operation they were ordered to life boats, in which they were taken ashore.

* * *

FRED C. DICKELY, chief operator of the United American Line passenger steamer *Resolute,* performed heroic work when fire broke out aboard the *S. S. Sudbury,* December 7, 1920, when over two hundred miles off the California coast. The fire was in close proximity to the vessel's fuel oil tanks and there was additional danger of it reaching a deck load of highly inflammable material. Dickely not only did his radio work, getting in touch with a naval vessel and having a fire boat come out to meet the ship, but also assisted on deck in cutting holes in the hatch and handling fire hose.

Thick smoke going down the ventilators to the engine room made working there extremely hazardous, and with steam being used to check the fire, the vessel's speed was cut to less than five knots an hour. Dickely was in the radio cabin and on deck twenty-seven hours and won through his courageous work much praise and admiration.

* * *

GORDON G. MACINTOSH, senior operator on the *Calvin Austin,* did good work when the *City of Rockland* ran ashore on the coast of Maine in September, 1923. He stood by in the radio cabin until the apparatus was rendered useless by water reaching the generator. During this time he was in peril as the guys to the smoke-stack and masts had snapped, which meant that the radio cabin was likely to be smashed in at any moment.

Macintosh had two previous experiences; once when the Shipping Board freighter *Cedar Springs* sprang a serious leak in 1920, and again when the tanker *J. E. O'Neil* caught fire in 1921.

WILLIAM F. C. HERTZ, who has been running between New York and European ports on the *S.S. Editor* for the past three years, showed his sticking qualities when the *Munairies* was rammed by a British ship on August 29, 1919. After sending out SOS calls he remained at his post while all on board, with the exception of the captain and ten of the crew, took to boats, from which they were rescued by the other ship. One quartermaster lost his life.

When asked why he had not gone with the others Hertz replied that he was so busily engaged in sending out the distress calls and listening to answers that it had not occurred to him. Help came through his work and the ship was towed into port.

This was the second time Hertz acted the hero part. On February 22, 1919, he sent SOS when the *Paloma* went ashore off the coast of Cuba. At that time also he remained on duty making no preparations to leave and with thoughts only of attracting help in the interest of the ship and the crew, rather than thinking of his own safety.

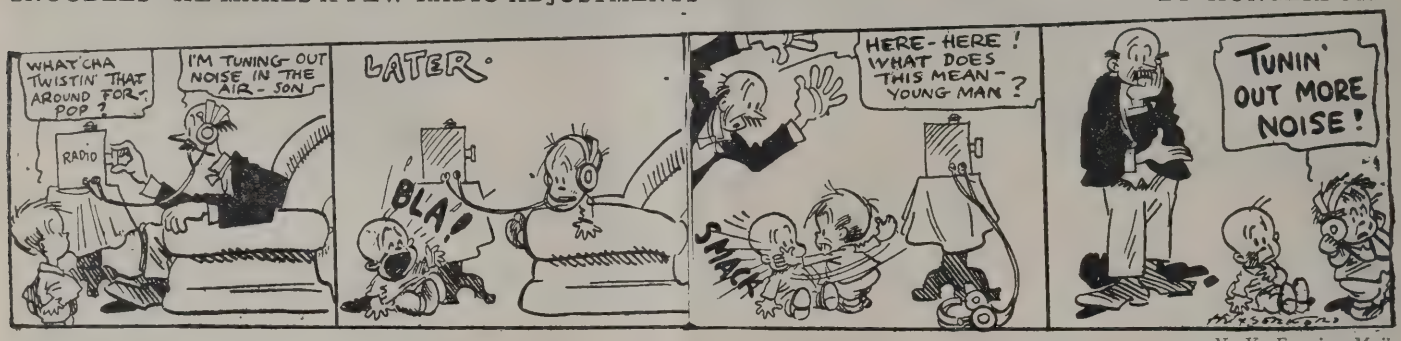
* * *

WILLIAM H. BARRY, a well known operator running out of New York, was on the *S.S. Aledo* enroute from Falmouth, England, to Jacksonville, Fla., during January, 1921, when the vessel encountered a hurricane which lasted a week. The mountainous seas shifted the cargo keeling the ship almost to her stability point. Water poured into the port holes and the pumps were going continuously. To add to the difficulties the vessel began to leak and several life boats were smashed. Barry kept a watch for fifty straight hours with only a package of hard-tack and a can of condensed milk to sustain him.

(*Continued on page 77*)

Best Bets in Humor

SNOODLES—HE MAKES A FEW RADIO ADJUSTMENTS — BY HUNGERFORD


WHAT'CHA TWISTIN' THAT AROUND FOR, POP?
I'M TUNING OUT NOISE IN THE AIR - SON
RADIO
LATER.
BLA!
HERE - HERE! WHAT DOES THIS MEAN - YOUNG MAN?
SMACK
TUNIN' OUT MORE NOISE!

—*N. Y. Evening Mail*

Dear Mr. Editor—I am a little 10 year old girl, poor but onest. My father made me a radio mashine which theys always a squeel and howl into it. I think my radio mashine aint all there. Pleäse where can I get a ohm or a ampere what want cost to much?

Last nite a grass hopper build a spider web on my condenser and I dont no what to do? Its bad luck to bust a spider web. Margold Cardillo.

P. S. Whats cats wiskers got to do with radio?

* * *

Fortunately, Margold cleared the way for a complete understanding of her social batting average. Poor, but none the less honest. We are not certain whether she meant to imply that being poor and honest all at the same time was rather a remarkable achievement, or simply that she is poor because she is honest. However, it is our opinion that she has qualified for an honest answer to her questions. It might be—but we apologize—that she made a point of honesty *for our benefit.*

To begin with, the radio market has been inexplicably depleted of slightly used ohms or amperes. Since The Wireless Age does not encourage price-cutting we must virtually insist that Miss Cardillo purchase these two commodities at list price.

As to the spider-web, we confess that at last we are at a loss to know what to advise. Our experience in "busting" spider webs is limited. We'd prefer to bust the grasshopper one in his antenna. Mr. Editor.

P. S. It just occurred to us that Margold's inquisitive nature may have prompted her to pull the cat's whiskers. If so, the howls in her radio machine would be accounted for. It sounds to us like the "cat's meow" anyway.

RAY D. O'FAN MAKES THE MOST OF SUMMER

—*Federal Telephone & Telegraph Co.*

CICERO SAPP — BY FRED LOCHER

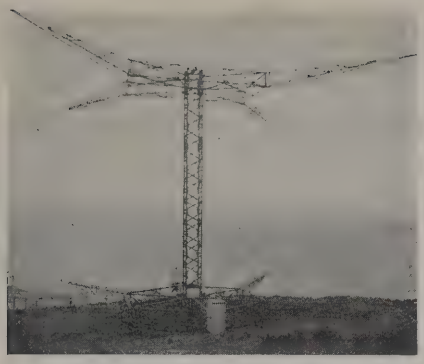
I HATE TO LAY DOWN ALL THIS DOUGH FOR A RADIO OUTFIT BUT IVE GOT TO SET AN EXAMPLE TO GIDSON AFTER THAT TALK I GAVE HIM YESTERDAY ABOUT USING HIS WILL POWER TO STAY AWAY FROM THE BALL GAMES
RADIO SUPPLIES
I CAN GET THE GAME PLAY BY PLAY OVER THIS MACHINE - AND IF HE SHOWS THE PROPER SPIRIT I'LL LET HIM "LISTEN IN" ONCE IN A WHILE -
I'LL JUST SNEAK OUT THE PRIVATE ENTRANCE AND GRAB A BITE OF LUNCH AND GET BACK WITHOUT HIM KNOWING I'M OUT -
WE OUGHTTA BE ABLE TO GET THE BASEBALL GAMES ON THIS - WONDER IF UNCLE CICERO THOUGHT ABOUT THAT?
OH BOY!!!

—*N. Y. Evening World*

BARNEY GOOGLE — BY DE BECK

MATCH RACE, FOR $5,000 SIDE BET BETWEEN "OI-YOI-YOI", THE PRIDE OF THE SOUTH AND THE WELL KNOWN "SPARK-PLUG" MISTER HIMELHOCH, OWNER OF "OI-YOI-YOI" IS IN THE GRAND STAND SURROUNDED BY BEAUTIFUL WOMEN - MR. GOOGLE - IS NOT PRESENT - THE HORSES ARE AT THE POST - THEY'RE OFF
MM
NECK AND NECK AT THE QUARTER - "OI-YOI-YOI" LEADS BY A HEAD AT THE HALF - THEY'RE IN THE STRETCH "OI-YOI-YOI" IS ONE LENGTH AHEAD - GREAT CHEERING
Copyright, 1923, by King Features Syndicate, Inc.
SPARK PLUG IS CLOSING THE GAP - A MAGNIFICENT SPURT AGAIN. THEY ARE NECK AND NECK -- SPARK PLUG WINS - I THANK YOU
SPARKY - MY BABY
SMACK SMACK SMACK SMACK SMACK
DE BECK
6-2

—*N. Y. American*



The antenna system of the beam transmitter at Inchkeith

Type V-2 Marconi broadcast receiver with loud speaker

Radio at the British Empire Exposition

The Marconi Company Exhibit at Wembley

A portable receiver. The Marconi R. P. 1 set

THE Marconi stand in the Electrical Engineering Section of the Palace of Engineering at the British Empire Exhibition, contains a great variety of exhibits representing the latest developments and appliances in all branches of wireless science.

The most prominent feature of the stand is the model of a wireless beam transmitter which is mounted on the roof and rotates slowly when in action. This apparatus represents one of the latest developments in applied radio work and is intended to enable all classes of coastal shipping fitted with an appropriate receiver, including vessels which do not carry wireless operators, to obtain bearings during fog when in the neighborhood of dangerous points. As it revolves, it signals to every two points of the compass a different Morse letter. These signals are transmitted on a very short wavelength, and are picked up by special receiving apparatus which is kept permanently tuned. By observing the Morse letters which his instrument receives the navigator is able to tell the direction of the transmitter, and by taking a succession of readings at intervals he can accurately chart his course.

In practice, the arc covered by the beam emanating from the transmitter is about 20 degrees at full strength, with a 10-degree fringe of about half strength each side. "Long" letters are transmitted at every two points of the compass, and "short" letters such as T or I at the intermediate points and half points. The navigator will therefore receive a range of letters such as —I Q I T I L I T. Since the letter Q stands for East-North-East, the first sound heard—the first I—will be a half point to the northward of East-North-East, and the last sound heard—the last T—will be a point to the southward of East. Halfway between these two will be the exact bearing, which is thus obtained within a quarter of a point.

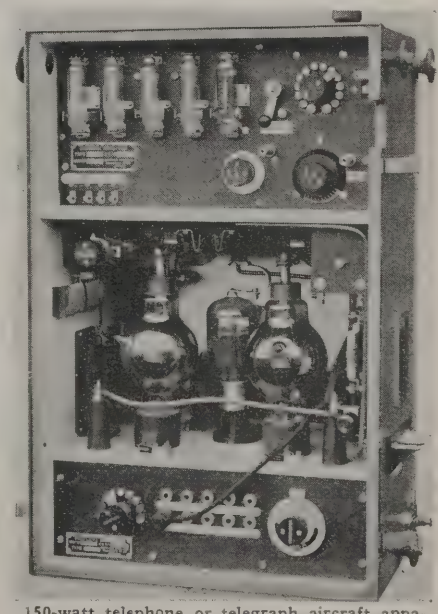
At the present time one of these projectors is operating on the Island of Inchkeith in the Firth of Forth, and another is being erected at the South Foreland.

After the beam transmitter, the most striking exhibits are two "valve pillars." The "valve pillar" is the latest design of electric oscillation generator which has been developed by the Marconi Company for use in high-power wireless stations.

The Marconi magnetic drum recorder is an instrument operated on a new magneto-mechanical principle. It is primarily a recording and relaying instrument for high-speed commercial wireless reception, but it can also be used for recording the time intervals between electric impulses, and can be made to rectify and oscillate and so perform electro-mechanically the same operations that a thermionic valve does electrically. It is extremely robust and many times more sensitive than any other form of electro-magnetic recorder. Its performance is unaffected by the rolling of a ship, shocks or vibrations, and it is therefore especially suitable for use at sea.

Other exhibits include the Marconi Wireless bell for use in wireless telephone apparatus designed to reduce the number of operators required in communication with lightships; aircraft transmitters and receivers of several types and a new airplane direction finder; field sets and pack sets for military use; a "popular" radio set suitable for the colonial farmer isolated from the centers of population; many kinds of marine wireless installations including the new Marconi wireless installation for ships' lifeboats. This set has been specially designed to be used under the most adverse weather conditions and in a very confined space.

The Marconi microphone used in British broadcasting stations. With this instrument it is possible to speak in a natural voice more than 30 feet away and get perfect transmission



150-watt telephone or telegraph aircraft apparatus in the Marconi exhibit

To Reanimate a Dead Receiver

What to Do When Your Set Goes Dead

This is the third of a series of articles on radio troubles and their remedies by the author. The first of this series dealt with set noises and the second with squeals

By R. A. Bradley

IN the past two issues we have endeavored to give the reader a general outline of procedure in eliminating various sources of trouble in a radio receiver. In most cases the receiver in question gives forth some noises or squeals which can be identified and which can be traced to the disturbing source by the character of the sounds. But most of us are completely stumped when no sign of life can be heard from the receiver. In other words, when the set goes dead the indications of trouble are scarce and less definite. In this instance the owner of the set must go through a series of experiments in order to determine the fault.

FIRST of all the natural question is, "Do the tubes light?"and analagous to that is the question, "Do they light to their proper brilliancy?" As we suggested before this cannot always be determined by the eye unless one has had much experience in this particular method of testing. Right here is where the pocket voltmeter plays its most important part. The average pocket meter on the market has two contacts, one on a short piece of insulated wire, the other, the case of the instrument. We have found it particularly helpful to solder, or fasten by some other means, a length of insulated wire, preferably stranded and flexible lamp wire, to the case of the voltmeter so that the two leads can be tucked into corners and cramped spaces in the process of testing out your circuits.

FIRST of all trace out the filament circuit from the battery to the binding posts on the set. From there follow the circuit through the rheostats to the socket terminals. Do not stop here, but make the test on the very contacts of the socket itself, that is, where the tube prongs touch the spring contacts. If you happen to have a blown-out tube a handy way of immediately determining this is to break the glass in the tube, place the remnants of your $5 in the socket, turn on the "A" battery switch and take your voltmeter reading across the two filament leads protruding through the glass stem of the tube. If the trouble is in your filament circuit somewhere on this route it will be clearly indicated by the voltmeter. If this circuit indicates that the voltage has reached the terminals of the tube and the tube still fails to light, the one answer is—a defective tube.

This is a most conclusive test and any trouble in the filament circuit will be indicated by the failure to obtain a reading on the voltmeter or a subnormal reading. In making the test be sure the contact with the voltmeter and the circuit is good and firm as otherwise the circuit may be complete and yet the reading on the voltmeter will show to the contrary.

FROM the "A" battery connections we go next to the "B" battery. On any set an instant indication of a properly hooked up "B" battery circuit is a pronounced click in the receivers when the plug is inserted in, or removed from, the phone jack. A click here indicates that the "B" battery circuit is complete, but it does not indicate the voltage of the "B" battery. Again our voltmeter comes into use. The "B" battery may be dead or in the last stages of exhaustion and this can be readily determined by the reading of your voltmeter. The most prominent "B" battery manufacturers recommend that when a 45-volt "B" battery drops below 37 volts, it should be discarded, as its effective life is exhausted. Likewise when a 22½-volt "B" battery has dropped to 17 volts it is time to junk it. Too low a detector "B" battery will, in some cases, prevent any signal from coming through the set. Some hard tubes on the market require a "B" battery in tip-top condition in order to function at all. Likewise an audio frequency amplifier or radio frequency amplifier will not function when the "B" battery voltage has dropped much below 45 volts. So you see, your voltmeter in both the case of the "A" battery and "B" battery is an important factor and a very necessary part of any radio owner's equipment.

FOR some reason the manufacturers of voltmeters have added an ammeter attachment to read direct current amperes. This is of absolutely no use to the owner of any radio set. In most cases this volt ammeter reads from 0 to 10 volts and 0 to 30 amperes. The chief delight of the "consulting radio engineers" whom we find in the corner radio store seems to be to place the ammeter across your prospective purchase of a dry cell or "B" battery. This tells nothing, does no good and a great deal of harm. An ammeter is a direct short in any circuit. In other words, it is a continuous circuit. A voltmeter is not, and for that reason a voltmeter reading may be obtained from your "B" battery or "A" battery and mean something. An ammeter reading across a new dry cell will generally give a reading of from 20 to 30 amperes. This means nothing, as the life of the battery is directly dependent upon the usage, the frequency of the drain and the amount of the drain. If both of these are small amounts, the life of the battery is then practically equal to its shelf life. It has been shown by actual test that to short a No. 6 dry cell (which is the same as putting an ammeter on it) for two minutes has an effect on its life equal to approximately two weeks continuous drain at one-quarter ampere. Hereafter when you buy your dry cells, just before the clerk puts his ammeter test on the battery, take a well aimed swat at him.

TO get back to our dead set, in testing out the "B" battery leads follow them through the circuit as you did the "A" battery leads and through the audio and radio frequency transformers. If the current does not pass beyond any one of the transformers in turn, you can generally be sure of an open circuit in that transformer. To be sure of this put your phones on and connect one side of the phones to a dry cell and then run leads from the other side of your phones and other side of your dry cell, first to the terminals of your primary transformer and then to the terminals of the secondary winding. In doing this never use more than 1½ volts as it is both detrimental to your phones and to the transformer. A loud click should be heard in the phones if the circuit is complete. In the case of the secondary winding, however, the click is not so marked. But any click at all here means a complete circuit.

TESTING THE TUBE SOCKETS

Now place your voltmeter with one terminal on the plate and the other on the negative lead of the "B" battery. If the circuit is complete a reading should be obtained on the voltmeter equal to, or nearly so, the voltage of your "B" battery. In any receiver except a neutralized tuned radio frequency set or a reflex set signals should not be heard after one tube is removed from the socket and when we say one we mean any one, detector or amplifier. If the tubes make poor contact with the prongs in the socket or do not make contact at all, the tube may light up, but the grid and plate connections may not be made. This must be remedied by placing the fingers in the socket and bending the prongs up so that they make good, firm contact. As we mentioned last month, a socket can cause a lot of trouble. It pays to have good ones in your set with good stiff springs making the contacts.

In a multi-stage audio frequency amplifier trouble may often arise which can be definitely located by plugging in the various jacks. For instance, if you have a two-step audio amplifier and you get no signals out of the second step jack, plug in the first step and detector. If you get signals in the first step, the trouble is in the second step and likewise if you plug in the first step and get no signals and the detector is working all right then the trouble is in the first step of amplification. Now this trouble may be in the jacks or in the transformers. Most generally it will be in the jacks. Sometimes the springs wear out and refuse to close the circuit through the transformer, in which case the signal in the detector tube never reaches the output of the second transformer. Good jacks do not give this trouble and have good stiff springs that always make contact. When you purchase a jack in a store, test the springs with your finger tips and be sure that there is plenty of life in them. It is hard to understand why people will put six or seven dollars into a stage of amplification and connect to the output of the detector with a ten-cent V&X jack. A jack is a delicate instrument and the best are none too good for the purpose.

If the trouble does not lie in the jack then it is bound to be in the transformer. There are some makes of transformers on the market which use very fine wire in both the primary and secondary and which are very easily blown out. These are very good transformers, as a rule, so far as amplification is concerned, but are not very rugged. In removing or connecting the "B" battery to your set it is always well to have the tubes turned off, otherwise the condenser formed by the transformer windings accumulates a charge which upon the removal of the "B" battery discharges or back-surges. This discharge generally has a voltage much higher than the voltage of a "B" battery and is injurious to the windings in some cases. Of course, the only remedy is to buy a new transformer as it is practically impossible to repair a blown out winding.

Another thing which can make an audio frequency amplifier go dead is the reversal of the "A" battery connections. This can generally be indicated by plugging in the detector and various amplifier jacks. It will be noticed that the normal amount of signal strength is present, but when you plug in the first jack the signal is greatly diminished instead of amplified. In the second stage no signals will be heard at all. The remedy for this, of course, is reversing the "A" battery connections.

Trouble in the tuner proper or in the detector circuit can be readily recognized by the sound in the phones when plugged into the detector jack. A hum in the phones like a motor generator indicates an open in the grid circuit that is somewhere between the grid of the detector tube and the filament return lead. An open in the plate circuit is indicated if there is no click present when the phones are inserted or removed from the jack. This click should be heard as the phone plug tip touches the contact spring of the jack. An open in the antenna or ground system, providing the detector circuit is O. K., can be noticed by the removal of the antenna wire from the binding posts and its replacement. When the antenna is disconnected from the ground it acts as a condenser with respect to the ground and, in fair weather especially, accumulates a charge of electricity. When the antenna is then grounded to the set it discharges at the moment of making contact and a slight click should be heard. In this test for an open circuit in the primary, the click indicates either poor aerial or ground connection.

In case this click is not heard one must also suspect a grounded aerial. This very often happens through cheap and unreliable lightning arresters. In purchasing a lightning arrester for your receiver, the fact that the Board of Underwriters has O. K.'d it is sufficient guarantee that it will operate satisfactorily for you.

Phone cords are another source of trouble in this line. Never allow your phone cords to come near the storage battery. A drop of acid on the phone cords will introduce a short circuit which will render the phones dead. This will not be denoted until after the acid has had a chance to eat well into the cords and the cotton or silk has started to become frayed.

In conclusion, when your set goes dead, stop a moment and think things over. Don't rush around, turning knobs and rheostats. That generally results in more trouble. If the set has been operating O. K. up to the present, consider that, in your search for the trouble. If the set has been idle look over your batteries first. Remember this, that if the set has worked the correction of whatever trouble exists will put the set back into operation again. Don't junk it first and then reconsider.

Marconi Suggests Medical Diagnosis by Radio

MEDICAL diagnosis by wireless telephony is the prophecy made by Senatore Guglielmo Marconi.

"Is it too much to suggest," Senatore Marconi says, "that at no distant date a doctor will be able to diagnose by wireless? The necessity for that may arise very naturally. A man in London, let us say, may require urgently the services of a particular doctor who at that moment is hundreds or perhaps thousands of miles away. To get the doctor to the bedside would involve delay that might be fatal.

"Who can say that in the future some means will not be perfected to permit the doctor, in certain circumstances, to study his patient and diagnose his complaint by wireless? Now that it is demonstrably practicable to send the sound of heart-beats through the ether so clearly, one cannot regard such developments as mere imagination.

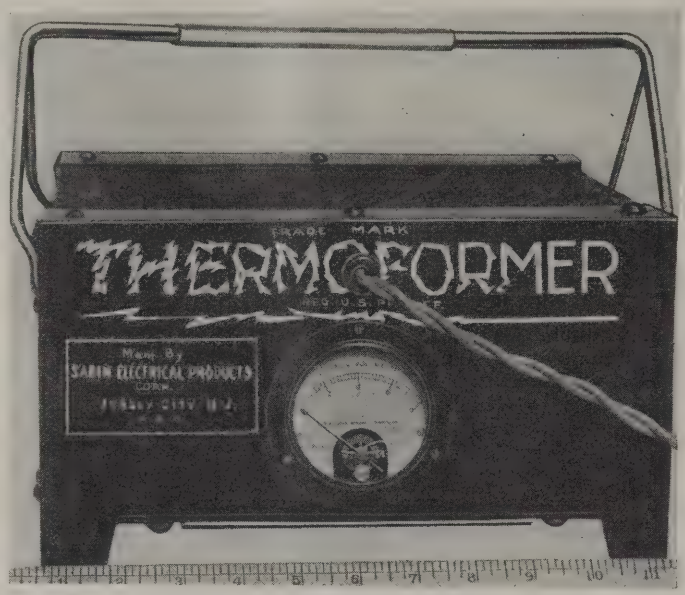
"The achievements already recorded are probably only a tithe of what will be accomplished in the future."

Radio Without Batteries

A New Development of Thermo-Electric Transformer to Make Possible Operation of Radio Receivers From Electric Light Current

THE problem of replacing batteries, especially storage batteries and rechargers by means of drawing directly upon the electric light current is one that has engaged the interest of many experimenters and engineers. Until recently results have not been specially encouraging. The hum resulting from the generator in producing electric lighting current was difficult to eliminate and there have been other obstacles.

R. E. Sabin, chemical engineer, of Somerville, N. J., with the co-operation of Mr. L. G. Pacent, radio manufacturer and engineer of New York City, seem to have worked out the practical solution of harnessing commercial electric light current to the usual radio receiving set. They have worked out an indirect method of harnessing commercial lighting current, in which such current is merely used as a source of heat, rather than as electrical energy.



The Thermoformer that makes possible the operation of tubes on A. C. or D. C. lighting circuits

Each bimetallic unit comprises a specially shaped casting of special metal for the hot member, and a channel-shaped piece of metal sheeting in contact with the upright leg of the hot member. The end of the horizontal leg of the hot member is in close thermal relationship with, but yet neutrally coupled electrically with, an electric resistor element which is operated directly on the commercial lighting current. To make the utmost use of the electrically-produced heat, the heating unit is made in the form of a flat unit placed between two rows of thermo-couple members. It requires about eight thermo-couple units connected in series to produce one volt of potential, so that for the type UV-199 tubes, requiring about 3½ volts for the filament, the "Thermoformer" comprises 32 units heated by two heater strips.

The entire assembly of thermo-couple units and heater strips is mounted in a metal case with perforated top and bottom plates, so as to provide the proper circulation of air. The thermoformer for six UV-199 tube filaments, which is the number for the present-day superheterodyne sets, occupies less room than the standard 6-volt storage battery.

The "Thermoformer" can be arranged to operate the filaments of a number of vacuum tubes, which is the more difficult task, as well as the high-voltage plate circuits which usually call for the so-called "B" batteries. Even the grid-biasing or "C" battery energy can be supplied by the "thermoformer." There is no hum or buzz or other indication of the lighting current used to operate the tubes.

Their thermoelectric power transformer consists of a number of pairs of dissimilar metals in contact, one junction being in close thermal relationship with, but neutrally coupled electrically from a resistor element in the power or lighting circuit. The difference in temperature between the metal members causes the flow of current, and while the potential of a single thermo-couple is quite low, any desired potential may be obtained by using a battery of bimetallic units connected in series.

Novel adjustments of the electrical resistances, thermal conductivities, emissivities, radiation, etc., of the various parts have been made, all contributory to the final perfected result.

The perfected thermoelectric transformer device, which has been given the significant name of "Thermoformer," consists of a neat pressed metal container in which are placed the several rows of bimetallic units, as well as the electrical resistor element. The lighting current is led directly to the resistor element, which operates in much the same manner as the heating element of an electric iron. This heat is brought to bear, without any substantial electrical coupling, on special electrode castings, while the other end of each of these special castings is in contact with a strip of metal which comprises the other member of the thermo-couple. The thermo-couple units are all joined together so that their individual electrical outputs are combined for the desired output. Furthermore, the container is provided with screened top and bottom to permit the passage of air to carry away the undesired heat.

Radio Generation of Inaudible Sounds

THE generation of "inaudible sounds" or, more accurately, super-audible vibrations, has been found recently to present decided possibilities in the realm of safety at sea. These vibrations are those of over 6,000 per second, just above audibility by the human ear, and their use has enabled the measurement of the depth of the sea and the distance of obstructions. The method used is to project these vibrations in water in a definite direction and measure the time elapsing before an echo returns, this being the scheme proposed to the French government by Mr. Chilowsky. This has even been used for the detection of submarines.

Recently Mr. Langevin has developed a new method, making use of a high frequency generator similar to that used in radio. His apparatus, when immersed in water, transforms the high frequency electrical energy into super-audible waves in the surrounding water, in the form of a beam that may be directed at will. The part of the apparatus that transfers the vibrations to the water corresponds to the antenna of a radio station, and may be used for both sending and receiving.

In operation, a ship in motion may send out a beam of these waves at will in any desired direction, and within an instant the return of the echo will announce the presence of an obstacle, if there is any. The speed of these waves is relatively slow, and measurement of the time is therefore easy and accurate.

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pitsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Newhouse Hotel.....Salt Lake City, Utah.	360
KDYM	Savoy Theater.....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYX	Star Bulletin.....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co. .....Seattle, Wash.	270
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing....Denver, Colo.	360
KDZR	Bellingham Publishing Co., Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co..Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co..Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn .....San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church.....Tacoma, Wash.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Leese Bros. .....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and The Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral .....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	238
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)..Billings, Mont.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	268
KFDJ	Oregon Agricultural College.....Corvallis, Ore.	360
KFDO	H. Everett Cutting.....Boseman, Mont.	248
KFDR	Bullock's Hdw. & Sporting Goods, York, Nebr.	360
KFDV	Gilbrecht & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEL	Winner Radio Corporation.....Denver, Colo.	360
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary.....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	Associated Engineering Societies of St. Louis, St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheffel Motor Co....Colorado Springs, Colo.	360
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co.....Omaha, Nebr.	278
KFFY	Pincus & Murphy.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co., Chickasha, Okla.	248
KFGH	Leland Stanford University, Stanford Univ., Calif.	360
KFGL	Snell & Irby .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Coll..Berrien Spgs, Mich.	286
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theater.....Hood River, Ore.	280
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co.....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seatle, Wash.	283
KFHX	Robert W. Nelson.....Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)....Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage.....Iola, Kans.	246
KFIF	Benson Polytechnic Institute.....Portland, Ore.	360
KFIL	Windisch Elec. Farm Equip. Co., Louisburg, Kans.	234
KFIO	North Central High School....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fond-du-Lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer.....Seattle, Wash.	270
KFJF	National Radio Mfg. Co., Oklahoma City, Okla.	252
KFJI	Liberty Theatre.....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co....Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.....Ottumwa, Iowa	242
KFJM	University of North Dakota, Grand Forks, N. D.	280
KFJQ	Electric Construction Co., Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJX	Iowa State Teachers College..Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112 Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers' Coll....Greeley, Colo.	273
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	250
KFKV	F. F. Gray .....Butte, Mon.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLP	Everette M. Foster.....Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co..Missoula,. Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College.....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KEMT	George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Satern.....Houghton, Mich.	266
KFMX	Carleton College.....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club...Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr.....Corsicana, Tex.	234
KFNF	Henry Field Seed Co.....Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop...Warrensburg, Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co.....Helena, Mont.	261
KFNZ	Royal Radio Co.....Burlingam, Calif.	231
KFOA	Rhodes Co.....Seattle, Wash.	455
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow.....Portland, Ore.	283
KFOJ	Moberly High School Radio Club, Moberly, Mo.	246
KFOL	Leslie M. Schafbuch.....Marengo, Iowa	234
KFON	Echophone Radio Shop.....Long Beach, Calif.	234
KFOP	Willson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFQE	Dickenson-Henry Radio Laboratories, Colorado Springs, Colo.	250
KFQF	Donald A. Boult.....Minneapolis, Minn.	
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock Watson Radio Service..Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times-Mirror Co.....Los Angeles, Calif.	395
KHQ	Louis Wasmer.....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	273
KJR	Northwest Radio Service Co....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Cal.	248
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Walter Hemrich.....Kukak Bay, Alaska	263
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co., Pittsburgh, Pa.	273
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazete.....Berkeley, Calif.	275
KSD	Post-Dispatch.....St. Louis, Mo.	546
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co....San Francisco, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner....Los Angeles, Calif.	360
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co., Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZN	Cape & Johnson.....Salt Lake City, Utah	268
KZV	Wenatchee Bat. & Motor Co., Wenatchee, Wash.	360
WAAB	Valdemar Jensen.....New Orleans, La.	268
WAAC	Tulane University.....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Neb.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	Harrisburg Sporting Goods Co..Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co....Bangor, Me.	240
WABL	Connecticut Agricultural College..Storrs, Conn.	283
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church..Rochester, N. Y.	252
WABP	Robert F. Weinig.....Dover, Ohio	266
WABQ	Haverford College Radio Club..Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. DeWitt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church.New Orleans, La.	263
WBAA	Purdue University.....West Lafayette, Ind.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBE	Alfred R. Marcy.....Syracuse, N. Y.	246
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya.....Mattapoisett, Mass.	240
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co., Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook .....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Association....Rossville, N. Y.	244
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	224
WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222

WBBY	Washington Light Infantry....Charleston, S. C.	268
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227
WBL	T. & H. Radio Co.....Anthony, Kans.	261
WBS	D. W. May (Inc.).....Newark, N. J.	360
WBT	Southern Radio Corporation...Charlotte, N. C...	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Bauer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel.....Houston, Tex.	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp. of Texas, San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.	280
WCAT	South Dakota State School of Mines, Rapid City, S. Dak.	240
WCAU	Durham & Co.....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont.....Burlington, Vt.	360
WCAZ	Carthage College.....Carthage, Ill.	246
WCBA	Charles W. Heimbach.....Allentown, Pa.	280
WCBC	University of Michigan.....Ann Harbor, Mich.	280
WCBD	Wilbur G. Voliva.....Zion, Ill.	345
WCBE	Uhalt Radio Co.....New Orleans La.	263
WCBG	Howard S. Williams.....Pascagoula, Miss.	268
WCBH	University of Mississippi.....Oxford, Miss.	242
WCBX	Radio Shop of Newark.....Newark, N. J.	233
WCBZ	Coppotelli Brothers' Music House, Chicago Heights, Ill.	
WCK	Stix-Baer & Fuller Dry Goods Co., St. Louis Mo.	360
WCM	University of Texas.....Austin, Tex.	360
WCX	Detroit Free Press .....Detroit, Mich.	517
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star.....Kansas City, Mo.	411
WDAG	J. Laurance Martin.....Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South), El Paso, Tex.	268
WDAK	The Courant.....Hartford, Conn.	261
WDAO	Automotive Electric Co.....Dallas, Tex.	360
WDAP	Board of Trade.....Chicago, Ill.	360
WDAR	Lit Brothers.....Philadelphia, Pa.	395
WDAS	Samuel A. Waite.....Worcester, Mass.	360
WDAU	Slocum & Kilburn.....New Bedford, Mass.	360
WDAY	Radio Equipment Corporation, Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.....Lancaster, Pa.	258
WDBL	Immanuel Lutheran Church of Valparaiso, Valparaiso Ind.	
WDBF	Superior State Normal School, Superior, Wis.	
WDM	Church of the Covenant.....Washington, D. C.	234
WDZ	James L. Bush.....Tuscola, Ill.	278
WEAA	Frank D. Fallain.....Flint, Mich.	250
WEAF	American Tel. & Tel. Co.....New York, N. Y.	492
WEAH	Wichita Board of Trade.....Wichita, Kans.	280
WEAI	Cornell University .....Ithaca, N. Y.	286
WEAJ	University of South Dakota..Vermilion, S. Dak.	283
WEAM	Borough of North Plainfield, North Plainfield, N. J.	252
WEAN	Shepard Co.....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co.....Mobile, Ala.	360
WEAR	Evening News Publishing Co....Baltimore, Md.	261
WEAU	Davidson Bros. Co.....Sioux City, Iowa	360
WEAY	Iris Theatre.....Houston, Tex.	360
WEB	Benwood Co.....St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	261
WFAA	Dallas News and Dallas Journal..Dallas, Tex.	476
WFAB	Carl F. Woese.....Syracuse, N. Y.	234
WFAM	Times Publishing Co.....St. Cloud, Minn.	273
WFAV	H. C. Spratley Radio Co...Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co., Asheville, N. C.	360
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College.....Cameron, Mo.	360
WFAT	New Columbus College.....Sioux Falls, S. Dak.	258
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd.....Pensacola, Fla.	360
WGAQ	Glenwood Radio Corporation....Shreveport, La.	252
WGAW	Ernest C. Albright.....Altoona, Pa.	261
WGAZ	South Bend Tribune.....South Bend, Ind.	360
WGI	American Radio and Research Corporation, Medford Hillside Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	242
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wis.	360
WHAA	State University of Iowa.....Iowa City, Iowa	484
WHAB	Clark W. Thompson.....Galveston, Tex.	360
WHAD	Marquette University.....Milwaukee, Wis.	280
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	Hafer Supply Co.....Joplin, Mo.	283
WHAK	Roberts Hardware Co.....Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music), Rochester, N. Y.	283
WHAP	Otta and Kuhns.....Decatur, Ill.	360
WHAR	Seaside House.....Atlantic City, N. J.	231
WHAS	Courier-Journal and Louisville Times, Louisville, Ky.	400
WHAV	Wilmington Elecl. Spec. Co., Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WHB	Sweeney School Co.....Kansas City Mo.	411
WHK	Radiovox Co.....Cleveland, Ohio	283
WHN	George Schubel.....New York, N. Y.	360
WIAB	Joslyn Automobile Co.....Rockford, Ill.	252
WIAC	Galveston Tribune.....Galveston, Tex.	360
WIAD	Howard R. Miller.....Philadelphia, Pa.	254
WIAF	Gustav A. DeCortin.....New Orleans, La.	234
WIAI	Heer Stores Co.....Springfield, Mo.	252
WIAJ	Fox River Valley Radio Sup. Co., Neenah, Wis.	224
WIAK	Journal-Stockman Co.....Omaha, Nebr.	278
WIAO	School of Eng'g of Milwaukee, Milwaukee Wis.	360
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Home Electric Co.....Burlington, Iowa	283
WIAU	American Trust Savings Bank, Le Mars, Iowa	360
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co., Washington, D. C.	360
WIP	Gimbel Bros.....Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories..Waco, Tex.	360
WJAG	Norfolk Dairy News.....Norfolk, Nebr.	283
WJAK	Clifford L. White.....Greentown, Ind.	254
WJAM	D. M. Perham.....Cedar Rapids, Iowa.	268
WJAN	Peoria Star.....Peoria, Ill.	280
WJAQ	Capper Publications.....Topeka, Kans.	360
WJAR	The Outlet Co.....Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250
WJAT	Kelley-Vawter Jewlry Co.....Marshall, Mo.	360
WJAX	Union Trust Co.....Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory.....Chicago, Ill.	448
WJD	Denison University.....Granville, Ohio	229
WJX	Deforest Radio Tel. & Tel. Co. New York, N. Y.	360
WJY	Radio Corporation of America, New York, N. Y.	405
WJZ	Radio Corporation of America, New York, N. Y.	455
WKAA	H. F. Paar.....Cedar Rapids, Iowa	268
WKAD	Charles Looff (Crescent Park), E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co....Wichita Falls, Tex.	360
WKAN	United Battery Service Co....Montgomery, Ala.	226
WKAP	Dutee W. Flint.....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College, East Lansing, Mich.	280
WKAV	Laconia Radio Club.....Laconia, N. H.	254
WKY	WKY Radio Shop.....Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation, Minneapolis, Minn.	417
WLAH	Samuel Woodworth.....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.....Tulsa, Okla.	360
WLAP	W. V. Jordon.....Louisville, Ky.	360
WLAQ	Arthur E. Schilling.....Kalamazoo, Mich.	283
WLAV	Electric Shop.....Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y., New York, N. Y.	360
WLAX	Putnam Electric Co.....Greencastle, Ind.	231
WLB	University of Minnesota....Minneapolis, Minn.	360
WLBL	Wisconsin Dep't. of Markets.Stevens Point, Wis.	
WLW	Crosley Mfg. Co.....Cincinnati, Ohio	309
WMAB	Radio Supply Co.....Oklahoma, Okla.	360
WMAC	Clive B. Meredith.....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co.....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.....Kansas City, Mo.	275
WMAK	Norton Laboratories.....Lockport, N. Y.	360
WMAL	Trenton Hardware Co.....Trenton, N. J.	256
WMAN	First Baptist Church.....Columbus, Ohio	286
WMAP	Utility Battery Service.....Easton, Pa.	246
WMAQ	Chicago Daily News.....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAY	Kingshighway Presby. Church, St. Louis, Mo.	280
WMC	Commercial Appeal.....Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co., Washington, D. C.	261
WNAC	Shepard Stores.....Boston, Mass.	278
WNAD	University of Oklahoma.....Norman, Okla.	360
WNAL	R. J. Rockwell.....Omaha, Nebr.	266
WNAN	Syracuse Radio Telephone Co., Syracuse N. Y.	286
WNAP	Wittenberg College.....Springfield, Ohio	275
WNAQ	Charleston Radio Elec. Co....Charleston, S. C.	360
WNAR	C. C. Rhodes.....Butler, Mo.	231
WNAS	Texas Radio Corp., and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Brothers Co.....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Telg. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzman....Box 167, Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co., Yankton, S. Dak.	244
WNJ	Shotton Radio Mfg. Co.....Albany, N. Y.	360
WOAC	Page Organ Co. (H. P. Maus).....Lima, Ohio	266
WOAD	Friady Battery & Elect. Corp., Sigourney, Iowa	360
WOAE	Midland College.....Fremont, Neb.	360
WOAF	Tyler Commercial College.....Tyler, Tex.	360
WOAG	Appollo Theatre.....Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation...Charleston, S. C.	360
WOAI	Southern Equipment Co....San Antonio, Tex.	385
WOAN	James D. Vaughn.....Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.....Mishawaka, Ind.	360
WOAP	Kalamazoo College.....Kalamazoo, Mich.	283
WOAR	Henry P. Lundskow.....Kenosha, Wis.	229
WOAT	Boyd M. Hamp.....Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 112th Inf...Erie, Pa.	242
WOAW	Woodmen of the World.....Omaha, Neb.	526
WOAX	Franklyn J. Wolff .....Trenton, N. J.	240
WOC	Palmer School of Chiropractic..Davenport, Iowa	484
WOI	Iowa State College.....Ames, Iowa	360
WOK	Pine Bluff Co.....Pine Bluff, Ark.	360
WOO	John Wanamaker.....Philadelphia, Pa.	509
WOQ	Western Radio Co.....Kansas City, Mo.	360
WOR	L. Bamberger & Co.....Newark, N. J.	405
WOS	Missouri State Market'g Bu., Jefferson City, Mo.	441
WPAB	Pennsylvania State College...State College, Pa.	283
WPAC	Donaldson Co.....Okmulgee, Okla.	330
WPAJ	Doolittle Radio Corp.....New Haven, Conn.	268
WPAK	North Dakota Agricultural College, Agricultural College, N. Dakota	360
WPAL	Avery & Loeb Electric Co.....Columbus, Ohio	286
WPAM	Auerbach & Guettel.....Topeka, Kans.	360
WPAP	Theodore D. Phillips.....Winchester, Ky.	360
WPAT	St. Patrick's Cathedral.....El Paso, Tex.	360
WPAU	Concordia College.....Moorhead, Minn.	360
WPAZ	John R. Koch.....Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.....Parkesburg, Pa.	360
WQAC	E. B. Gish.....Amarillo, Texas	234
WQAE	Moore Radio News Station....Springfield, Vt.	275
WQAF	Sandusky Register.....Sandusky Ohio	240
WQAL	Coles County Tele. & Teleg. Co., Mattoon, Ill.	258
WQAM	Electrical Equipment Co.....Miami, Fla.	283
WQAN	Scranton Times.....Scranton, Pa.	280
WQAO	Calvary Baptist Church.....New York, N. Y.	360
WQAQ	W. Texas Radio Co. (Abilene Dairy Reporter) Abilene, Texas	360
WQAS	Prince-Walter Co.....Lowell, Mass.	266
WQAW	Catholic University.....Washington, D. C.	236
WQAX	Radio Equipment Co.....Peoria, Ill.	360
WQJ	Calumet Rainbow Broadcasting Co., Chicago, Ill.	
WRAA	Rice Institute.....Houston, Texas	360
WRAF	The Radio Club.....Laporte, Ind.	224
WRAH	Stanley N. Read.....Providence, R. I.	231
WRAL	Northern States Power Co., St. Croix Falls, Wis.	248
WRAM	Lombard College .....Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.....Waterloo, Iowa	236
WRAO	St. Louis Radio Service Co.....St. Louis, Mo.	360
WRAV	Antioch College .....Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop.....Reading, Pa.	238
WRAX	Flexon's Garage.....Gloucester City, N. J.	268
WRAY	Radio Sales Corporation.....Scranton, Pa.	280
WRC	Radio Corporation of America, Washington, D. C.	469
WRK	Doron Bros. Electrical Co.....Hamilton, Ohio	360
WRL	Union College.....Schenectady, N. Y.	360
WRM	University of Illinois.....Urbana, Ill.	360
WRR	City of Dallas, Police and Fire Signal Dept. Dallas, Texas	360
WRW	Tarrytown Radio Res'rch Lab., Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College, Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural Col., Clemson College, S. C.	360
WSAD	J. A. Foster Co.....Providence, R. I.	261
WSAG	Loren V. Davis and George Prestman, Sr., St. Petersburg, Fla.	244
WSAI	United States Playing Card Co., Cincinnati, O.	309
WSAJ	Grove City College.....Grove City, Pa.	360
WSAN	Allentown Radio Club.....Allentown, Pa.	229
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co....Plainview, Tex.	268
WSAW	John J. Long, Jr.....Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory.....Chicago, Ill.	268
WSAY	Port Chester Chamber of Commerce, Port Chester, N. Y.	233
WSAZ	Chase Electric Shop.....Pomeroy, Ohio	258
WSB	Atlanta Journal.....Atlanta, Ga.	429
WSL	J. & M. Electrical Co.....Utica, N. Y.	273
WSY	Alabama Power Co.....Birmingham, Ala.	360
WTAC	Penn Traffic Co.....Johnstown, Pa.	360
WTAF	Louis J. Gallo.....New Orleans, La	268
WTAG	Kern Music Co.....Providence, R. I.	258
WTAH	Carmen Ferro.....Belvidere, Ill.	236
WTAJ	The Radio Shop.....Portland, Me.	236
WTAL	Toledo Radio & Electric Co.....Toledo, Ohio	252
WTAM	Willard Storage Battery Co.....Cleveland, O.	390
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son.....Osseo, Wis.	254
WTAR	Reliance Electric Co.....Norfolk, Va.	280
WTAS	Charles E. Erbstein.....Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co., Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co..Tecumseh, Nebr.	242
WTAW	Agricultural and Mechanical College of Texas, College Station, Tex.	280
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcast. Sta., Oak Park, Ill.	283
WTAZ	Thomas J. McGuire.....Lambertville, N. J.	283
WTG	Kansas State Agri. Coll.....Manhatan, Kans.	360
WWAB	Hoenig, Swern & Co.....Trenton, N. J.	226
WWAC	Sanger Bros.....Waco, Tex.	360
WWAD	Wright & Wright (Inc.)....Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley.....Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAO	Michigan College of Mines....Houghton, Mich.	244
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	Detroit News.....Detroit, Mich.	517
WWL	Loyola University.....New Orleans, La.	280

Canadian Stations

CKLC	Wilkinson Electric Co., Ltd.....Calgary, Alta.	400
CJCD	T. Eaton Co., Ltd.....Toronto, Ont.	410
CFCU	Jack V. Elliot, Ltd.....Hamilton, Ont.	410
CFLC	Chas. Guy Hunter.....London, Ont.	430
CHCS	The Hamilton Spectator.....Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd....Montreal, P. Q.	341
CFCF	Marconi W/T Co. of Can., Ltd, Montreal, P. Q.	440
CKCO	Dr. G. M. Geldert.....Ottawa, Ont.	400
CHNC	Toronto Radio Research Society, Toronto, Ont.	350
CKCH	Canadian National Railways.....Ottawa, Ont.	435
CJCM	J. L. Philippe Landry.....Mont Joli, P. Q.	312
CHXC	J. R. Booth, Jr.....Ottawa, Ont.	435
CHCE	Western Canada Radio Supply, Victoria, B. C.	400
CKY	Manitoba Telephone System....Winnipeg, Man.	450
CKCD	Vancouver Daily Province....Vancouver, B. C.	410
CFCA	Star Publishing & Printing Co., Toronto, Ont.	400
CFAC	The Calgary Herald.....Calgary, Alta.	430
CKAC	La Presse Publishing Co., Ltd., Montreal, P. Q.	430
CFCH	Abitibi Power & Paper Co., Ltd., Iroquois Falls, Ont.	400
CJCF	The News Record.....Kitchener, Ont.	295
CJGC	London Free Press Printing Co., Ltd., London, Ont.	430
CFRC	Queen's University.....Kingston, Ont.	450
CFCQ	Radio Specialties Ltd.....Vancouver, B. C.	450
CFDC	Sparks Company.....Nanaimo, B. C.	430
CJCA	The Edmonton Journal, Ltd....Edmonton, Alta.	450
CFCK	Radio Supply Co., Ltd.....Edmonton, Alta.	410
CJCE	Sprott Shaw Radio Co.....Vancouver, B. C.	400
CFCL	Centennial Methodist Church, Victoria, B. C.	400
CJSC	The Evening Telegram.....Toronto, Ont.	430
CFYC	Victor Wentworth Odlum.....Vancouver, B. C.	400
CFXC	Westminster Trust Co..New Westminster, B. C.	440
CKCI	Le "Soliel" Limitee.....Quebec, P. Q.	295
CFQC	The Electric Shop, Ltd.....Saskatoon, Sask.	400
CHBC	The Albertan Publishing Co.....Calgary, Alta.	410

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower)	2,600
8AJ	Paris	1,780
ESP	Paris	450

Cuban Stations

PWX	Cuban Telephone Co.....Habana	400
2DW	Pedro Zayas .....Habana	300
2AB	Alberto S. de Bustamante.....Habana	240
2OK	Mario Garcia Vélez.....Habana	360
2BY	Frederick W. Borton.....Habana	260
2CX	Frederick W. Borton.....Habana	320
2EV	Westinghouse Elec. Co.....Habana	220
2TW	Roberto E. Ramirez.....Habana	230
2HC	Heraldo de Cuba.....Habana	275
2LC	Luis Casas .....Habana	250
2KD	E. Sanchez de Fuentes.....Habana	350
2MN	Fausto Simon .....Habana	270
2MG	Manuel G. Salas.....Habana	280
2JQ	Raul Pérez Falcon.....Habana	150
2KP	Alvaro Daza .....Habana	200
2HS	Julio Power .....Habana	180
2OL	Oscar Collado .....Habana	290
2WW	Amadeo Saenz .....Habana	210
5EV	Leopold V. Figueroa.....Colon	360
6KW	Frank H. Jones .....Tuinucu	340
6KJ	Frank H. Jones .....Tuinucu	275
5EV	Leopoldo V. Figueroa.....Colon	360
6DW	Eduardo Terry .....Cienfuegos	225
6BY	José Ganduxe .....Cienfuegos	300
6AZ	Valentin Ulivarri .....Cienfuegos	200
6EV	Josefa Alvarez .....Caibarién	225
7AZ	Pedro Nogueras .....Camaguey	225
7BY	Salvador Rionda .....Camaguey	350
8AZ	Alfredo Broocks .....Santiago de Cuba	240
8BY	Alberto Ravelo .....Santiago de Cuba	250
8FU	Andrés Vinnet .....Santiago de Cuba	225
8DW	Pedro C. Anduz .....Santiago de Cuba	275
8EV	Edurado Mateos .....Santiago de Cuba	180
8GT	Juan F. Chibas.....Santiago de Cuba	260

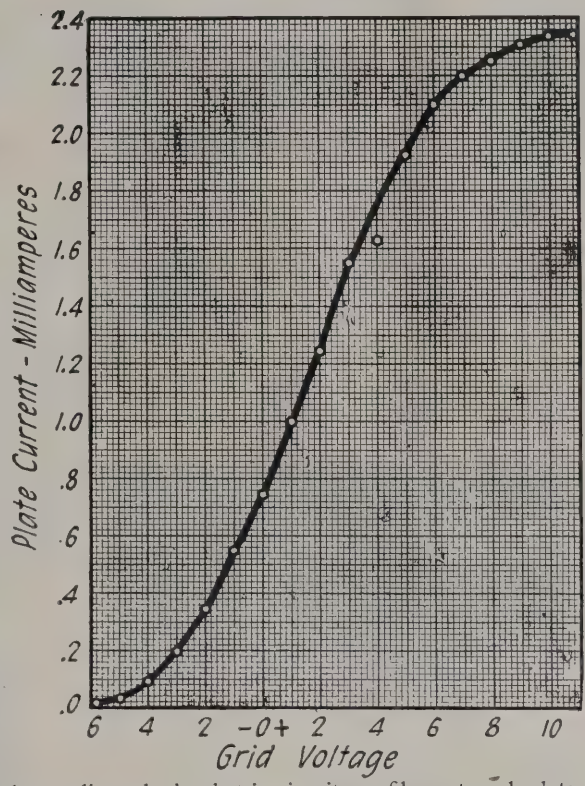
RADIO ENGINEERING

An Experimental Home-Laboratory Course in Simple and Advanced Radio Design

By John R. Meagher

Circuits

THE other day we were talking to a radio manufacturer about circuits, at the same time illustrating our point with quickly sketched diagrams. Some of these were simple one-tube layouts; others were more complicated, ranging from four-tube reflexes to eight-tube "supers." The manufacturer after agreeing with our views expressed surprise at the rapidity with which the diagrams were sketched. Merely to show him there "was nothing to it" we spent a half hour teaching him the correct way of sketching diagrams—and at the end of that time he surprised even himself with his speed and accuracy in drawing up a five-tube radio "freq" circuit. And what was still more pleasing to us, he was able to talk more intelligently about the circuit—for the lesson had not been so much in sketching diagrams as it had been in understanding what's what in circuits.



This is how the curve should appear as drawn from the data in last months' Radio Engineering. Note that the point at the intersection of 1.65 (plate current) and 4 (grid voltage) is out of line. If the figures were secured in an experimental set up it would be probable that this measurement was incorrect in some way. In drawing curves the idea usually is to follow the general trend and have a smooth rather than an erratic curve

The thought occurred to us—why not try the same thing in *"Radio Engineering"* for if the students can acquire this knack it will place them at a distinct advantage over other radio men.

So, instead of Vacuum Tubes or Inter-Tube Coupling we will devote this sheet to circuits—how to know them and how to sketch them.

Start always with the filament circuit if the diagram must be complete. In general there is only one type—a filament or A battery shunted by one or more filaments, each filament having an extra resistance of some sort in series with it. Imagine a step ladder with the leads from the battery or the "battery lines" forming the sides; one rung forming the battery itself and the other rungs representing separate filaments and their extra resistances. That is rather a simple picture; and is it any more difficult to conceive of each rung being twisted out of shape? Then why is it more difficult to understand the simple parallel circuit (remember the rungs of the ladder are in "parallel") with real battery lines and "rungs" of filaments bent and twisted up somewhere above the lines? By way of illustration follow through any of the circuits published in this issue.

Make it an invariable rule to place the rheostats in the negative side of the circuit. Thus if we start from the negative battery line we should go through the rheostat first, then the filament, and finally return to the positive side of the line.

Sketch out some plain parallel filament circuits; make the battery lines heavy for distinction. Nothing to it, is there? Now put a filament battery switch in. It should be between the battery and everything else so the battery is really disconnected. Place it in the negative lead so it will be at the lowest potential—ground potential if the negative A battery is grounded. Insert a potentiometer—yes, it can go anywhere along the battery lines just so long as one end of the resistance touches the negative line and the other end the positive line. It should of course be on the filament side of the battery switch.

Now draw plate and grid symbols near the filaments: put the grids between the filaments and the plates.

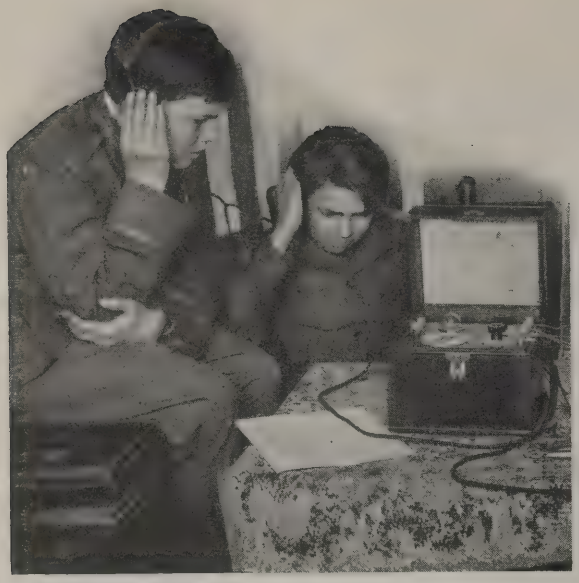
If we are going to draw a straight transformer coupled amplifier let us complete either the plate or grid circuits first.

Starting from each plate go through the RF section first (if there is any RF section in the plate circuit) then through the AF section and through the plate battery to the filament. The circuit from filament to plate is completed by the electronic flow between the filament and plate when the filament is heated. When the filament is cold and there is no flow of electrons the circuit is opened.

Each plate is the same and we can show separate plate batteries if desired merely to show the similarity, but as the impedance of the plate battery to any frequency is very low it has been found possible to use a common plate battery as there is no noticeable coupling between the circuits. But understand that the common plate battery may be thought of as separate batteries for each plate and it is at once evident why any voltage of the total plate battery may be used on any plate. Thus with a five-tube set, say we had a 100-volt battery and each plate went to a different tap, say 20V, 40V, 60V, 80V and 100V. We could think of this arrangement as being five separate batteries with all the negative leads connected to the filaments and the positive lead of the 20V battery going to one plate, the positive lead of the 40V battery going to another plate and so on. Or we can think of the plate with 20V as having an effective voltage of 20 and a "dead end" of 80.

Now for the grid circuits: from the grids go through the secondaries of the coupling devices and down to the filament. With AF amplification these "return leads" from the grid should go to the negative filament battery line or else to a grid battery which may be separate for each grid or common for a number of grids. The reasoning of this is the same as for the plate battery as given above.

The grid return leads from short wave RF amplifiers are sometimes connected to the slider of a potentiometer connected across the A battery so the grid voltage can be controlled, and sometimes to the negative filament battery line either direct or through an adjustable resistance. The grid return of a detector with a grid condenser and shunt leak is almost invariably brought to the positive filament battery line.

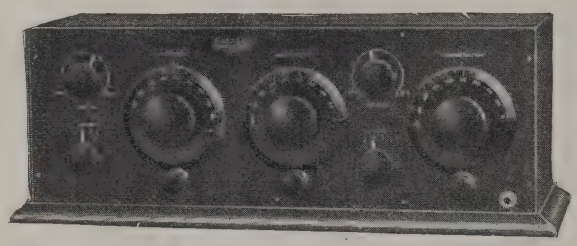


A Contest for All Radio Sets

This is an opportunity every Every contestant can earn radio The element of chance has been on individ-

THIS is a contest that every live youngster will want to enter. And this is why:

During the summer months you can earn what you want in radio as a full-fledged salesman on THE WIRELESS AGE Sales Staff. Every boy who enters this contest automatically becomes a member of our organization and is paid well for his time. This is a contest in which you are being paid for the time you devote to winning a prize.



First Prize—Paragon RB2 $135.00 Receiver.

Second Prize—Thompson Magnaphone $35.00 Loud-Speaker.

Third Prize—N&K Imported $8.50 Headset.

The contest closes September 15th. All subscriptions for the contest must be in this office not later than that date.

The rules of the contest will be found on this page.

In the event of ties, each tying contestant will be awarded a prize identical in character with that tied for.

This contest is open to all live youngsters who wish to earn their own radio sets.

For example, suppose you won the Paragon RB2 $135.00 receiver. You would have a radio set that you could well be proud of. In the first place, you would have one of the finest receivers manufactured by the Adams-Morgan Company. In the second place, you would have earned that set, and could appreciate its value far better than another youngster who must depend upon his parents.

And what happens to the subscriptions you have secured in order to win the RB2 receiver? Just this:—they bring to you the aerial, and batteries, and loud speaker that you must have before the set is complete. Providing, of course, you have secured enough subscriptions for the additional parts. You will very likely have more than enough—enough more to get a voltmeter or some other instrument you would like to have.

Supposing, for another example, that you won the second or third prize? You would then have a Thompson Magnaphone $35.00 loud speaker, or an imported N&K $8.50 headset. You would also have enough subscriptions to bring to you other parts as explained for the first prize.

Even though you did not win one of the three prizes, you would still have a job that would provide you with the things you want most in radio. It is a job that you can still have through the winter. When this contest is over, another one will be offered if there are enough boys still able to continue with the work. * * *

I want 10,000 young men to join the sales staff of THE WIRELESS AGE. Each one will be well paid.

I will teach you how to sell subscriptions, supply you with samples, give you a calling list, and then send you out as a full-fledged salesman. I will then establish a credit account in your name. You can draw from that account just as you like. It will enable you to buy radio parts at wholesale prices.

You will receive from a list of 35,000 names of people who own radio sets, those who live in your district. Some of them have been taking this magazine, but have forgotten to renew their subscriptions. All of them own radio sets, and, of course, will want to know more about THE WIRELESS AGE. I have sent letters to these people so that they will know about this magazine even before you call on them.

You will have my guidance at all times. You may depend upon me for instruction and encouragement. Those who are now on the staff have all made good. The reason is that I have

Boys Who Want
or Parts

lively youngster will welcome.
parts while trying for the prizes.
removed, thus offering rewards
ual merit

wanted to make good myself and I now intend to see all the others make good.

Write to me NOW. Address your letter to the Boys' Editor, THE WIRELESS AGE, 326 Broadway, New York City.

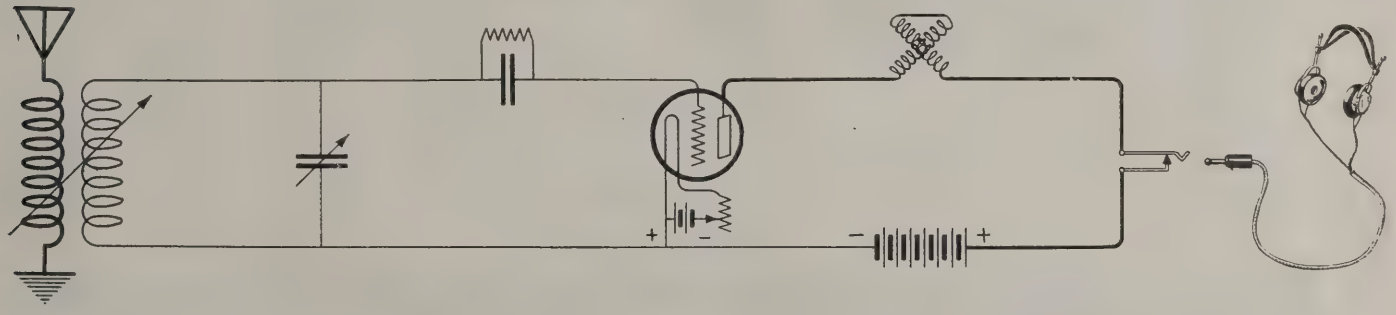
If you have a pal or two, write together. Sometimes team work is better than working alone. But write to me at once, without delay.—BOYS' EDITOR.

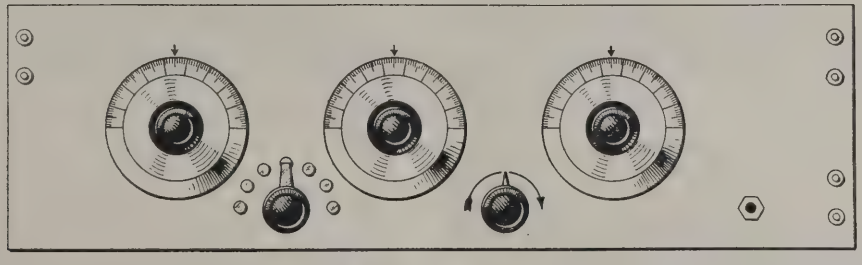
* * *

THE diagram below, illustrates ONE set you can earn during the summer months. If you now have some of the parts, the remainder can be earned with fewer subscriptions. But this is only ONE of the many sets you can earn. Perhaps there are other hook-ups you like better, or perhaps you prefer a set completely assembled. Whatever you do want, you can earn under our careful guidance.

Simply write to us:—tell us what you want, and we will show you how to get it.

Is there anything below you would like? It is yours if you want it.





LIST OF PRIZES

		List Price
Aerial Outfit	—Storm King Complete	$4.00
Vario Coupler	—Pall Mall	2.00
Variometer	—Pall Mall	2.00
Condenser	—Pacent—21 Pl. Variable	3.75
Phones	—N&K Imported	8.50
"B" Battery	—Eveready 22½ V.	2.50
"A" Battery	—Eveready 1½ V.	.40
Grid Condenser	—Dubilier Ducon .00025	.75
Grid Leak	—Pacent 3 Megohm	.50
Vacuum Tube	—RCA—WD-12	5.00
Dials (3)	—Na-Ald 3″	1.00
Panel	—Radion 7″ x 21″ x 3/16″	2.65
Jack	—Pacent single circuit	.60
Rheostat	—Pacent	1.00
Plug	—Pacent Duoplug	1.00
Socket	—Na-Ald Bakelite	.35
Binding Posts (8)	—Eby	1.50
		$37.50

Selected Radio Hook-Ups

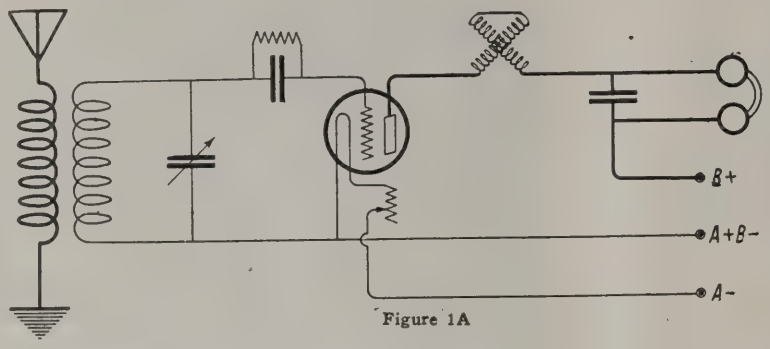


Figure 1A

FEW of us are content or satisfied with any one set or circuit for a length of time. We make a set, play with it, take it apart and put it together again. When we have reached the limit of its possibilities, we turn to another circuit. When you have become initiated into this you have approached the amateur fever. Valuable experience which can be obtained in no other way may be had by the constant construction and operation of various types of receivers.

Since the decrease in popularity of the regenerative set everyone seems to want to convert his receiver into a tuned radio frequency set. The hook-up of the average regenerative set is shown in figure 1A. This consists of the ordinary variocoupler whose secondary is shunted by a variable condenser and a variometer in series with the plate circuit. In the next diagram it is shown how this same set may be converted into a tuned radio frequency amplifier using all the apparatus which you had in the original set. With only the addition of a potentiometer and a different sized grid condenser this may be very easily accomplished as shown in the diagrams figures 1A and 1B. In order to do this remove the grid condenser and grid leak from the tube in figure 1A, shunt the "A" battery with a 400-ohm potentiometer and connect the grid return lead from the secondary of the coupler to the arm of the potentiometer. The grid condenser is omitted since no condenser is used in a radio-frequency amplifier. The grid receives a natural bias by means of the potentiometer adjustment.

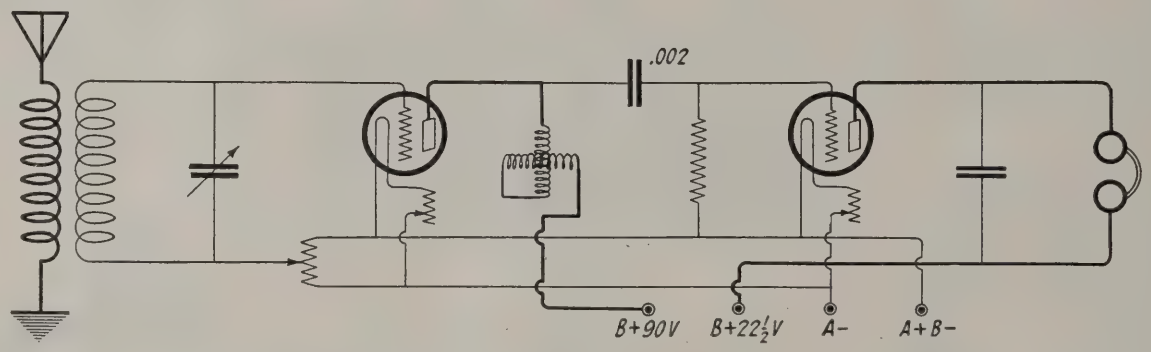


Figure 1B

IN figure 1B we have the changed hook-up. This constitutes one stage of tuned grid and plate or tuned impedance radio-frequency amplification ahead of the detector. As the diagram shows ninety volts is applied to the plate of the radio-frequency tube and 22½ volts to the plate of the detector tube. Of course audio-frequency amplification may be added to this circuit without affecting it. The primary of an audio-frequency transformer being substituted for the phones in the circuit, it is quite essential that the grid leak be placed as shown in the diagram from grid to positive filament. A two-megohm grid leak will generally be found to be satisfactory.

FIGURE 2 is a new adaptation of the old two variometer variocoupler set. The plate variometer instead of being inserted between the plate and the phones is part of the grid tuning circuit as well as the plate. The path of the radio-frequency current is then from plate to the plate variometer to the secondary of the coupler to the grid variometer and so on back to the grid. The phones or primary of the amplifying transformer generally form enough of a radio-frequency choke to prevent the RF current from flowing through them. This circuit is very smooth in its operation and the control of regeneration is remarkably stable. Any type of tube can be used with this circuit and the batteries should correspond with the tube used. If the circuit does not oscillate it may be helped along by the insertion of a radio-frequency choke between the point where the plate variometer is inserted in the plate circuit and the phones. A .00025 mfd. variable condenser will serve as well as any.

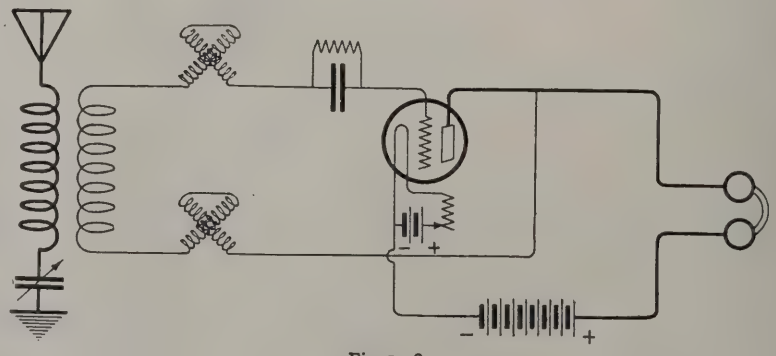


Figure 2

The grid leak will depend upon the type of tube used. For the UV-200 no grid leak was used at all.

For the Home Builder

HERE we have the hook-up of the old Aeriola Sr. probably the best compact vacation set yet manufactured. The two variometers have forty turns on their rotors and stators each. The two coils between the left hand variometer and the ground consist of 10 turns, each one is placed in inductive relation to the grid variometer and the other in inductive relation to the plate variometer. The 2 antenna series condensers are a .001 and a .00025 mfd. respectively. The tap switch shown is connected in series with the antenna and may be thrown from one condenser to the other. The .0001 mfd. will serve for short wave stations, that is 220 to 350 meters, and the .00025 mfd. for long waves, 350 to 500 meters. This can be made into a very small set which can be taken along on trips to the country. A seven by ten panel will be sufficient and the two variometers may be fastened to the panel together with a rheostat and tap switch and phone-jack. There need be no other controls on the panel. As dry cell tubes are used the set may be entirely self-contained except for the aerial and phones. The incorporation of the small sized "B" batteries and dry cell "A" batteries and the addition of a carrying strap fastened to the top of the cabinet make this truly a portable receiver. Care should be exercised in the purchase of parts and all metal surfaces should be nickeled to prevent oxidation from dampness.

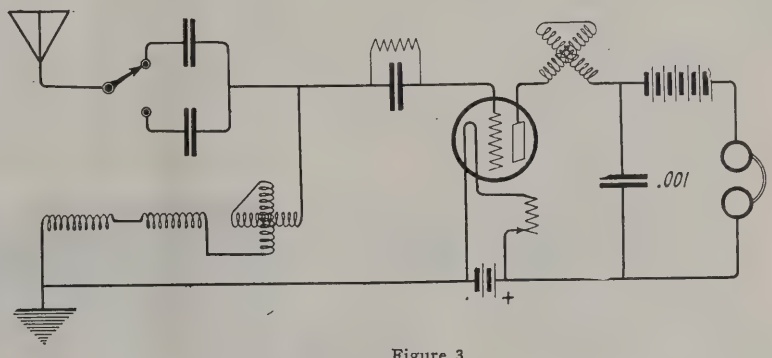


Figure 3

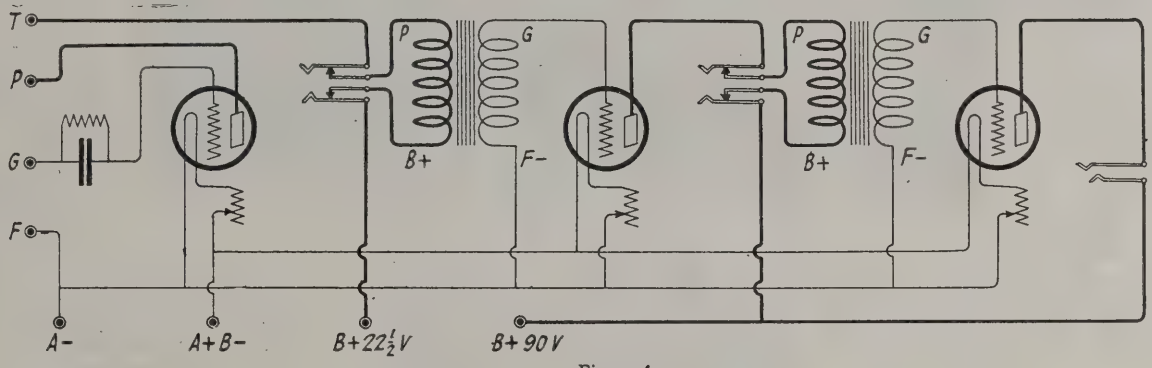


Figure 4

THE handiest thing we know of around an experimenter's laboratory is a two-step amplifier with detector complete in a separate unit by itself. To this may be added all sorts of tuners and various hook-ups tried. Figure 4 shows such an arrangement. There are eight binding posts on the set, three rheostats, two transformers, three tube sockets and three jacks. All this can be arranged on a standard seven-inch by ten-inch hard rubber panel fastened onto a baseboard six inches by nine inches. The transformers may be mounted on the extreme rear of the baseboard and the three sockets placed between the transformers and the panel. Three small rheostats are mounted on the panel.

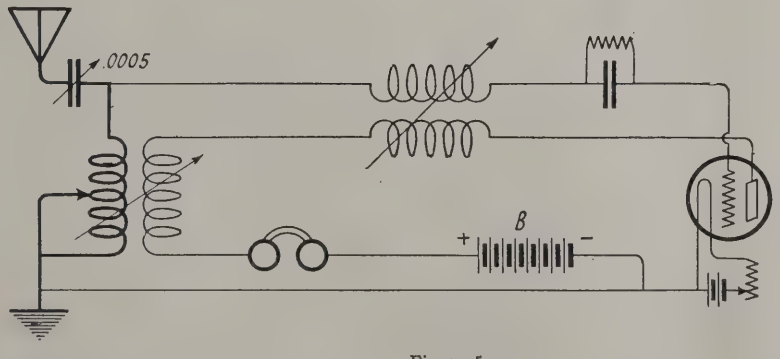


Figure 5

FIGURE 5 is a very sensitive regenerative set. The two pairs of coils are two variocouplers or two variometers with their windings split. A very fine degree of regeneration is obtained and the tuning is very selective. The .0005 mfd. variable condenser in the antenna circuit is not essential, but is of assistance in tuning. It may be found helpful to shunt the phones and "B" battery with a .0005 mfd. or a .001 mfd. variable condenser. The tube used may be a WD-11, or 12, or UV-199, 201A or 200. The "B" battery voltage and "A" battery voltage will depend upon the tube used, of course. If a variocoupler is used in the right hand pair of coils the taps need not be used. However, it is desirable to tap the primary winding of the left hand pair.

The action is quite simple. The stator windings of the two couplers comprise the grid and antenna circuits while the rotor coils are double ticklers with feedback in the antenna circuit and the grid circuit. This permits close regulation of the degree of regeneration and is consequently extremely sensitive to broadcast transmitters.

Warp & Weft of Radio Minds

VARIETY IN VIEWPOINTS

DOES R-A-D-I-O spell *finis* to the burlesque theater reeky with smoke, the pool parlor, and Dinty's? Is restless Out-At-All-Hours to be caught and anchored safe in Home Bay—by Radio? Is *paterfamilias* to be restored to its ancient definition by the magic of condensers and coils and telephone jacks?

Mr. Thompson, a regular reader and a "regular feller," he who does such clever cartoon-postals on which to correspond with his friend THE WIRELESS AGE that they get published now and then—says that, for his part—

"I believe that it is essential for every business man to have a hobby. I wanted a hobby that my family could share in, a hobby that would give me diversion, but also the companionship of my family, and especially my boys. Radio seemed to fill the requirements. I started with a one bulb set and in a few weeks got my first DX station. Then I was a semi-Fan. Then came the three bulb set, and more DX stations. Then I was a real fan. Then came the five bulb set, and the thrill of hearing the announcer say, 'This is Station KHJ, Los Angeles, California.' Now my wife says I am not a radio fan—but a 'BUG.'"

THE companionship of his family—especially "my boys!" Just let that thought wriggle through the wrinkles of your cerebrum—if a wave of that glorious size can get through.

Mr. Thompson having become a "Bug," apparently settled down to serious operation of his set. He sends the following for the benefit of others who have experienced similar difficulties:

"For several weeks each night, after nine o'clock, a cracking noise, so loud that it would drown out all other reception, would come on my set. After testing and making sure it was not the fault of the set I called in the Electric Light Co., and in order to further prove that the trouble was on their lines they, one night after midnight, turned out all the town lights. The cracking stopped at once. This proved that the trouble was either on their lines or was coming in on their lines. Several tests were made and nothing could be found that would cause such a noise on the power lines. Finally I had a loop made and tested with that. This being a directional loop it showed the direction from which the noise was coming. The Electric Co. delegated a man to work with me and we set up my set in an automobile and since the loop gave us the direction we started in the car towards the noise. After riding around in circles for an hour we finally came in front of a house where the noise seemed the loudest. The electric light man climbed the pole and cut the lighting wires running to this house and at once the noise stopped. We then found that the only thing turned on in the house was an electric heating pad. As soon as the wires had been connected up again, we tested the pad and found two bad connections. These connections were fixed and we have had no more cracking."

Radio School in the Chicago Boys' Club

OLD-TIME KEY-POUNDER'S RECOMMENDATION

"BEING an old timer in telegraphy (commenced in 1879), my favorite pastime in the evening is to tune in one of those copper plate senders working one of the New York control trans-atlantic stations, or 'K E T' at Bolinas, and sit in and copy him for an hour or so. It is a real pleasure to copy their stuff, as they are all beautiful senders; steady, smooth and fast.

"I went through the usual spasms of assembling, tearing down and rearranging different kinds of hook-ups for long distance reception, and finally settled upon the ordinary regenerative tickler circuit with honey-comb coils (primary, secondary and tickler), as the best all around arrangement for long wave, high power stations."

GEO. H. HAZELTINE,
Fort Stockton, Texas.

BEFORE you blame your radio receiver, and the broadcast stations and atmospheric conditions, better snoop around and spot the bad connections. Don't concentrate on heating pads; there are curling irons and egg-cookers and carpet sweepers, not to mention a million others more or less.

A short time ago a radio club sent out members on a hunt for trouble and found it where a bare electric wire came in contact with a tree. Radio as an electric leak detector!

RADIO ENGINEERS OF THE FUTURE

A LETTER was received from Mr. A. R. Snyder letting us about the radio activities of the Chicago Boys' Club. Knowing what is being done for our boys is surely worth while. Mr. Snyder writes:

"Boys of today are going to be the radio engineers and experts of the future. The Chicago Boys' Club knows that the little chaps have keen minds and is doing all it can to encourage them in the study of radio. At Club No. 2, 1725 Orchard St., there is a complete radio laboratory and workshop, where the young fellows are given an opportunity to build and test receiving sets and experiment with various parts.

"Remarkable results have been obtained in this workshop. Quite a number of the boys have developed unusual ability in their new craft. Be it a crystal set, four-circuit tuner or neutrodyne, you will find anywhere from one to dozens of them being constructed in the radio department of the club.

"The club has now fostered the radio department for two years and has not only turned out hundreds of radio fans, but the sets made would make a real radio show all by themselves if they could be got together. All the way from crystal sets, which cost less than $1.00—complete without phones—to massive outfits.

"An experimental department is conducted for testing hookups. This part of the work is under the direction of A. E. Haase, the club's radio expert. Classes in wireless telegraphy are being given so that radio fans turned out by this department can read code as well as listen to the voice over the radio phones. The club is hoping to have an amateur station in the near future through which it can transmit news items to the 4,000 boys who are members of the five branches of the Chicago Boys' Club."

Even boys who are fortunate enough to have a daddy like friend Thompson need to work and play with their own kind. Boys' clubs have a precious opportunity, which radio has come to improve many-fold.

THE Boy Scouts of America have a membership enrollment of five hundred thousand. Of this number a large majority have adopted radio—construction, operation and experimentation—as a very important part of their activities. The same thoroughgoing procedure marks their activities in radio as it has in all other subjects.

Radio Activities Broaden in Scope

THIS MONTH

Permanent Radio Exposition—
Radio Enthusiasts in India—
Origin of Applause Cards—
Evolution of Carboniferous Deposits—
Saint-Gauden's "Diana" an Aerial—
Honeycomb Coils Patent Award—
Importance of Serial Numbers on Sets

RADIO is to be an important feature of the Permanent Industrial Exposition of Newark, N. J. The main structure will contain seven floors, including the basement, and will be surmounted by a tower rising to a total height of 235 feet, the tallest structure in New Jersey. Illuminated by special electrical devices, this tower will be a conspicuous landmark for the thousands who pass through the city daily on seven railroad trunk lines.

It is planned to install in the building a powerful transmitting station, to be used for the dissemination of price quotations and exposition news among the buyers of the country.

Radio will be featured as a department of the exposition by giving as much space as may be desired to manufacturers of equipment of all kinds. Newark's importance in the radio field is one reason why the exposition plans to develop radio as one of its prime activities. These activities are, however, national in scope and exhibits will be received from manufacturers anywhere in the country.

* * *

CATALOGS and price lists for American receiving sets and parts for amateur assembling are wanted by radio enthusiasts in India. Firms interested are requested to send such literature to the American Trade Commissioner, James E. Miller, Esq., Room 29, Grosvernor House, 21 Old Court House Street, Calcutta, India, who will be glad to make it available to those interested.

* * *

THE man who invented "Applause Cards" emerges from the shadows at last. Mr. Percy W. Andrews, Manager of the Radio Division of the Dictograph Products Corporation, and the man responsible for this revolutionary radio invention, has at last

Percy W. Andrews, manager Radio Division of the Dictograph Products Corp.

consented to tell the world how he landed the "big idea."

"It happened on the 8.14," answered Mr. Andrews. "I was sitting in the smoking car on this particularly bright morning, not so many months ago, musing over the Philharmonic concert I had heard via radio, the night before. The concert had been wonderful. My wife and I had enjoyed it immensely.

"Mentioning the fact to my neighbor across the aisle, brought a sympathetic response. He, too, you see, had been listening in, and like myself and probably thousands of other fans, he had neglected to go to the trouble of writing in his appreciation.

"'If we only had some sort of printed cards to just sign and drop in the box,' I ventured to him. 'Sort of applause cards.'

"'That's it!' he chimed in, 'applause cards!" And that was it.'

"Study of the proposition, conversation with dealers, jobbers and other

A. M. Joralemon, sales manager of The Crosley Radio Corporation

fans assured me that the idea was sound; that applause cards would fill one of the greatest needs of broadcasting today.

"Well, everybody knows the rest. 'Applause Cards' are being given away free by thousands of radio dealers all over the country. The fans are taking and using them as fast as we can print them."

* * *

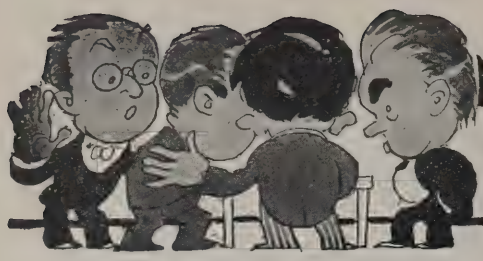
THE Robert L. Stillson Company has just published "The Story of Bakelite" by John Kimberly Mumford. It is an impressionistic piece of writing in Mr. Mumford's best style. Beginning with the genesis of Bakelite in the morning of the world, it carries the reader through its gradual evolution down to present day developments and uses.

While not in any sense a text book or technical presentation of the subject, it contains much serviceable information presented with accuracy and simplicity of statement. Altogether, it makes a readable little volume.

* * *

IT is barely possible that the far famed bronze statue, "Diana," which surmounts the tower of Madison Square Garden and which is universally acclaimed as one of the finest pieces of sculpture in existence, may soon adopt a more useful profession than that of a beautiful weather vane. In other words, Saint-Gaudens' masterpiece may go into the radio business and establish herself as the world's most exquisite antenna.

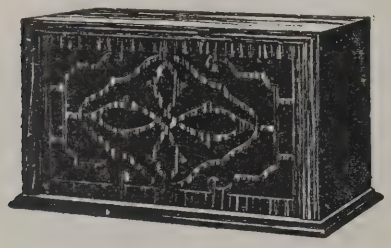
(*Continued on page 90*)



NEW APPLIANCES AND DEVICES

Sonora Radio Speaker

THE Sonora Radio Speaker is the same patented all-wood horn used in the Sonora Phonograph, with a Sonora tone arm and radio reproducer, encased in a typical Sonora cabinet. This is the tone passage which enabled Sonora to win highest award for tone quality at the Panama-Pacific Ex-



position and to be recognized as the sweetest toned phonograph. Embodied in the Sonora Radio Speaker, it imparts the same clarity, sweetness and volume to radio reproduction.

The Sonora Radio Speaker is the creation of experts in tone production—their contribution to the advancement of radio science.

It is a beautiful article of furniture. Its small size enables you to place it on top of your set, or on the table alongside. It is equipped with cord and connection, ready to be attached to your set.

Crosley 51-P

UNLIKE most portable receivers, the case of the Portable 51—known as the Crosley 51-P—has ample room for a real power plant of batteries instead of a limited space for flashlight batteries, which have a short life, even on dry cell tubes. The Crosley 51-P has ample space for three full-sized, six-inch No. 6 dry cells to furnish the filament current for either UV-199

or WD-12 tubes, giving economical life and not necessitating frequent renewal of "A" battery. There is also room for three Eveready No. 764 vertical, intermediate 22½-volt "B" batteries, or the equivalent No. 5158 Burgess or No. 1153 French batteries, thus giving 67½ volts for the plates of the tubes, which means ample loud speaker volume under proper conditions. There is also room for a "C" battery, and provision is made for connecting in a "C" battery if desired. There is also room for one or two coils of insulated flexible wire to be used as an antenna and ground wire, as well as a compartment for head phones.

The Kellogg Universal Panel Radio Kit

THE Kellogg Switchboard & Supply Company have placed on the market a universal radio panel kit with audio amplification apparatus. This universal panel enables the buyer to mount three tuning units in any combination that he desires—that is, either two condensers or one coupler; two variometers and one coupler; two variometers and one condenser; one coupler, one condenser; or one variometer; or three condensers, covering practically every type of hook-up.

The size of the panel and apparatus per-

mit of the widest selection of circuits. The contents of this kit are as follows:

One panel drilled Kellogg Bakelite, 8½ inches high, 23¼ inches long, 3/16 inch thick; one mounting bracket, zinc, heavily enamel insulated; one shield, aluminum, eliminates body capacity; one insulator, bakelite panel strip for insulating rheostat mountings; one binding post strip, bakelite; seven No. 504 binding posts, with tinned terminals; three No. 502 dials, 4 inch diameter, ¼ inch holes, bushings for 3/16 inch and ⅛ inch shafts; two No. 501 transformers, ratio 4⅛ to 1; two No. 502 switch contacts, silver plated, for decreasing resistance; nine No. 501 switch stops, silver plated; one No. 545 switch lever, silver plated; two No. 505 jacks, standard; one No. 504 jacks, standard; one No. 501 hardware, machine screw nuts, terminals, spring washers; one No. 501 S. plug; one bottle liquid spaghetti, for insulating the wiring; two No. 506 miniature condensers; one No. 503 mounting 4½ in. bakelite base, spring clip for two fixed condensers, takes all standard sizes; one No. 501 rheostat, 6-ohm resistance, for detector control; two No. 502 rheostats, 25 ohms resistance for amplifiers; three No. 2 tube sockets, bakelite reinforced slot, tinned terminals and double lock washers; one set Elco transfers, for labeling the controls; one 3 foot length spaghetti, maroon, for insulating parts of wiring as desired; one-eighth lb. Kester resin core solder, the right kind to use; 30 feet No. 16 bare tinned copper wire.

Na-Ald Super-De Luxe Dial

THE Alden Manufacturing Company of Springfield, Massachusetts, have just placed on the market a new dial called the Na-ald Super-De Luxe Dial. This product

rounds out the very complete line of dials manufactured by the Alden Manufacturing Company. It is manufactured in the 3⅞-inch size.

Like the other Na-ald Dials the Super-De Luxe is manufactured from black Bakelite with uniform back ribbing. Graduations and numbers are placed on the bevel of this dial and are marked with a permanent, brilliant white. The dial is provided with a large positive grip set screw. No special screw driver is required for setting.

The Addition to the Audiophone Line

THE Baby Audiophone is the latest addition to the Bristol family of loud speakers, and the one which is pictured above is now finished with a fiber horn.

This loud speaker like all the other Bristol products, may be used on two or three

stages of amplification. It is of the same high grade construction and material as the rest of the line. A metal horn and fifteen-inch bell is optional equipment, if desired in place of the fiber horn.

"Eldredge" Ironclad A. F. Transformer

THE "Eldredge" Iron Clad Audio Frequency Transformer made by the Eldredge Electric Manufacturing Company, Springfield, Mass., is said to give uniformity of tone reception throughout the whole scale with maximum amplification and

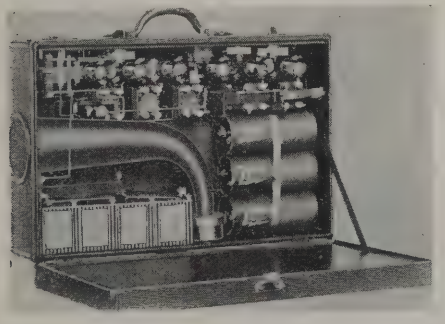
elimination of distortion. Long distance reception in sets using these transformers from London, England, and Catalina Island, California, has been accomplished.

Tops and bases are of best quality bakelite. Laminations and shield containing coil are of high silicon steel. The shield is one continuous strip of seven complete turns of unique construction. The core is of combined air and specially treated iron. The workmanship and material is guaranteed free of all defects when shipped from factory.

The New Zenith Super-Portable

THE new Zenith Super-Portable is a six-tube radio set complete with tubes, "A" batteries, "B" batteries, loud speaker and loop antenna, entirely self-contained. It is fitted into a small, beautifully finished traveling case—a most compact set giving clarity, quality, volume and distance.

In the case are included all the essentials of an efficient six-tube receiver employing three stages of transformer-coupled radio frequency, a detector, and two stages of



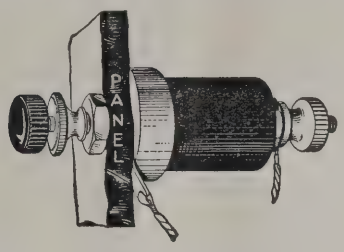
audio frequency. The set is dry-cell operated. A loop antenna is permanently mounted inside the case, and the three controls—(1) A rheostat for regulating the battery current; (2) Tuning control for selecting stations; (3) Volume control—are mounted close to the handle in three recessed dials.

The Zenith Super-Portable weighs only twenty-four pounds and may be carried about like an ordinary small suit-case.

No external aerial is required for operating the Zenith Super-Portable, nor is it necessary to open the case. The set is operated by means of two controls, both on top of the case. Having tuned in the station you want, volume can be further regulated by swinging the case so that the loop is pointed in the direction of the station broadcasting. A station may be tuned and the Super-Portable placed in full operation while it is being carried down the street, in an automobile or otherwise transported.

Foote Variotector for Reflex Panel

THE Foote Variotector is especially designed, with its accompanying binding posts, for mounting back of the panel in



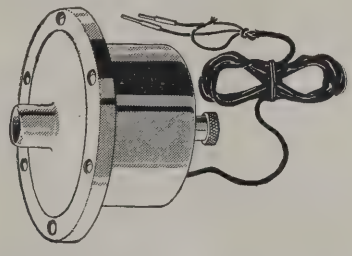
tube sets, as its micrometer rod allows the necessary adjustments for reflex circuits. Only one ¼ inch hole in the panel is required for mounting. There is a solder connection to front terminal lug while the other connection is made to a binding post in the rear.

The variotector is equipped with a lock nut permitting permanent adjustment of the cat whisker with maximum audibility. It is very rugged in construction and will last indefinitely. The gold cat whisker provides two non-corrosive non-vibrating contacts.

These various features, combined together with ease of mounting on the panel and simplicity of construction recommend the variotector for reflex work.

K-E Phonograph Unit

A SPECIAL phonograph unit is now being made by the Kirkman Engineering Corporation of New York City, manufacturers of the K-E Loud Speaker.



This Phonograph Unit—like the Loud Speaker—incorporates the unique K-E 4-inch diaphragm. The 4-inch diaphragm is the secret of the clearness with which the K-E Loud Speaker, and now the Phonograph Unit, deliver their great volume.

A control knob on the back permits the volume to be increased or diminished by a twist of the wrist. The terminals of the standard length phone cord are completely enclosed.

Probably the most important feature of the K-E Phonograph Unit is that it will fit all makes of phonographs! This point will make the economy of a phono-attachment available for the thousands of radio enthusiasts possessing phonographs which cannot be fitted with ordinary attachments.

New Magnavox Reproducer

THE Magnavox Company is now distributing to the trade an entirely new model reproducer designated, M4.

This instrument makes use of the semi-dynamic operating principle developed by Magnavox engineers and first employed by them in the M1 Reproducer brought out a little less than a year ago. The M4 repre-

sents a further perfecting of this principle, especially the new magnetically balanced armature, the improved type of diaphragm supported by hollow rubber gaskets, and an extremely high resistance winding which makes M4 unusually sensitive.

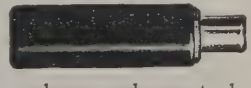
It is said that by eliminating moving parts, joints and other mechanical connections, the semi-dynamic operating principle makes possible a consistently higher quality of musical tone than any other instrument not requiring a battery for its operation.

Some of the other important features incorporated in the semi-dynamic mechanism are: a special large permanent magnet obviating use of field battery; a sound chamber designed on true acoustic principles, and a correct balance between size of diaphragm and vibrating air column in horn—this last being the factor which insures reproduction in high pitch. In the design of this model, much attention has been given to the matter of finish and general appearance. A new and very beautiful effect has been obtained by a gold trim applied in contrast with the dark blue enamel of the curvex horn and base.

The Magnavox line of radio reproducers, by this addition, now includes models of both the electro-dynamic and semi-dynamic types—R3 and R2 electro-dynamic, and M1 and M4 semi-dynamic—prices ranging from $25.00 to $50.00. It is possible to select from these four Magnavox models a reproducer perfectly adapted for use with any type of receiving set.

Carter Portable Jack

THE Carter Radio Company has developed a portable jack for head phone and loud speaker and extension cord. It permits



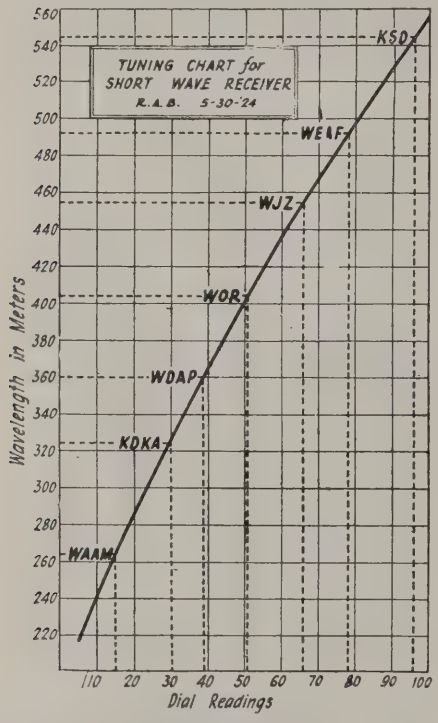
the loud speaker or phones to be extended to an adjoining room or porch. It has been found of great convenience in camping and touring. The cord may be attached to the set with a plug or to the binding posts. The portable jack will accommodate any standard radio plug.

CONDUCTED BY R. A. BRADLEY

Due to the great volume of correspondence which this department entails we are forced to remind our readers on the following points: Be sure to enclose a self-addressed stamped envelope with your letter. Make your questions clear and concise. If you wish information on your set please enclose a rough sketch or hook-up if possible. Do not ask us to make comparisons between different makes of apparatus or sets.

F. J. Perce, Allentown, Pa.—I have been told that a tuning chart will aid me in finding distant stations. Will you please tell me how to make one of these?

A tuning chart or curve can be easily made by the owner of a radio set and is of great assistance in finding stations when only the wave length of the stations is known. A sheet of cross-section paper divided into 10 sections to the inch should be secured and arranged as shown in figure 1. As you see, this is marked on one axis with numbers ranging from 0 to 100 by



10's. This represents degrees on the dial of your wavelength control, whatever it may be, a variometer or a variable condenser. The numbers on the other axis represent the wavelength range. Now in order to make the curve you must plot a few points to begin with of the stations which you receive readily and whose wavelengths are known. There should be four or five stations plotted at least. After you have found the points on the graph for these stations draw a smooth curve through the various points. If this curve is carefully drawn it will be quite accurate enough to be of valuable assistance to you in tuning in stations which you have not heard before. On a tuned radio frequency set having two or three wavelength control dials it will be necessary sometimes to make three separate graphs, one for each dial. On the other hand if the set is well made and the leads short the chances are that the dial readings on at least two of them are the same and one graph can be used for the two of them. Of course this curve cannot be strictly accurate because broadcasting stations as a rule do not adhere to the licensed wavelength which they have been assigned. For instance there is one station in New York City licensed to operate on 360 meters and on a precision wave meter this station was found to vary from 358 to 366 meters in a month's time. Stations KDKA and WGY maintain their constant transmitting wave at all times, varying less than 2 per cent.

Mr. S. E. Murdock, Washington, D. C.—I have been using a three honeycomb coil detector and two-stage amplifier with much satisfaction, but after reading the June issue of THE WIRELESS AGE, page 64, I thought that it was a good plan to re-build my set using one stage of radio frequency. I would like to have a diagram showing

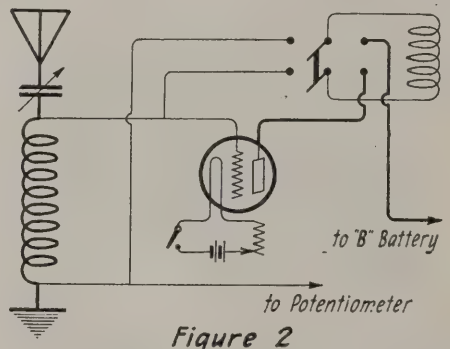


Figure 2

how I may switch off the radio frequency tube when receiving local stations.

The switching arrangement is shown in figure 2. This incorporates an anti-capacity switch, three-pole, double throw. When the switch is thrown to the radio frequency side the filament of the radio frequency tube is lit and a primary honeycomb coil is connected to the plate and "B" battery of the radio frequency tube. When the switch is thrown the other way the filament on the radio frequency tube is turned out and the primary coil connected to the aerial and ground.

Mr. T. P. Vaughan, Alexandria, Va.—I am very much interested in the article by R. B. Bourne in the May issue of THE WIRELESS AGE on short wave reception. What is the tube voltage and the audio frequency transformer ratio?

This receiver used a UV-200 as a detector which of course takes five volts at one ampere. A 201-A will probably work as well in this connection. The ratio of the audio frequency transformer was 10 to 1.

Mr. Joseph Schenckel, Hasbrouck Heights, N. J., asks.—What is meant by the mutual conductance of a tube? Also what effect has it on the operation of a tube?

The mutual conductance of a tube is the rate at which the plate current changes with respect to the grid voltage. In other words the mutual conductance is the slope of the plate current grid voltage curve. In figures 3 and 4 we have two such curves for two different tubes. It will be seen in figure 3

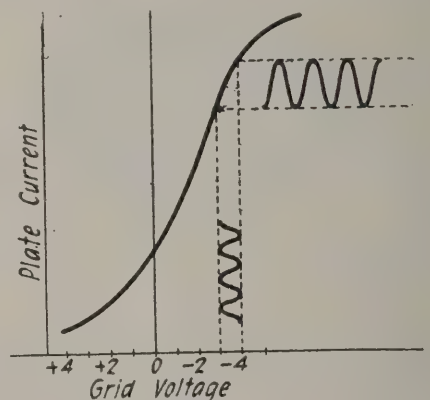


Figure 3

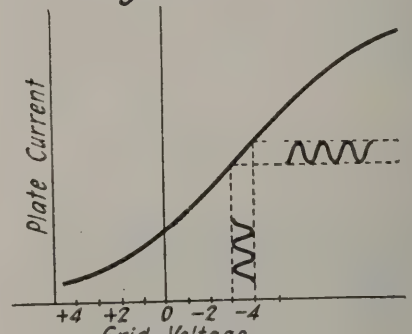


Figure 4

that for very slight changes in grid voltage on the steep part of this curve there are very great changes made in the plate current and consequently a loud signal is produced in the phones. In figure 4 we have a curve of another tube whose amplification factor is much lower and the slope of the curve is much more gradual. Let us now impress a grid voltage varying from three volts minus to four minus and see what we get in changes of plate current. You will note that the changes in plate current in this tube compared with the changes in the other tube are very small. In other words, the first tube had a higher amplification factor or mutual conductance than the second tube. The first curve closely resembles that of the UV-201A or 301A. The second is an approximate curve of the WR21A.

(*Continued on page 77*)

Afloat and Ashore With the Operators

(*Continued from page* 59)

Being at the point of exhaustion he was about to go to the adjourning sleeping room when he thought it best to remain in the room near his apparatus. He was napping but a few minutes when awakened by a crash. The bow of a steel life boat had smashed into the sleeping quarters and struck the bunk on which he would have laid.

The antenna carried away twice and each time Barry assisted in reconstructing it. There was eleven feet of water in the hold and the seas were so high it was impossible for other ships to approach and effect a rescue. The vessel finally made St. George, Bermuda.

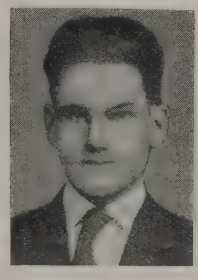
* * *

DWIGHT HOWLAND passed through a thrilling experience during which he proved his bravery when the *Moreni* sank after a two-hour fight with a submarine on June 12, 1917. Throughout the fight Howland continued his radio communications until a shot through the radio cabin knocked the chair from under him and blew the phones off his head. This caused wounds about his face, hands and legs and happened a few minutes before the fatal shot which sank the ship. Howland was obliged to jump into the sea and swim a long distance to a boat. He was then made a prisoner of war by the submarine, but later released.

His junior operator, James J. Curran lost his life. Howland at the time was nineteen years old and upon his return to America further showed his bravery by immediately shipping on another vessel for the war zone.

* * *

HARVEY R. BUTT, who recently became district manager of the Radio Corporation's Norfolk office, was operator on the *S.S. Alamance* when that vessel sank February 5, 1918. After a torpedo struck the vessel Butt reported to the captain who informed him there was no need of sending out a call as another ship was then in sight. He stood ready, however, to stick should there be work for him to do. Later from the deck of the rescuing ship he witnessed his own vessel stand up on her end with the stern under water, pose a minute then drop quickly from view carrying along his clothes and effects.



HENRY T. MUNROE, an operator running out of Boston, gained recognition in 1918, when the *S.S. Currier* ran aground and stuck fast six days and twenty hours, during which Munroe worked incessantly. After the third day the provisions became exhausted, adding to the discomforts.

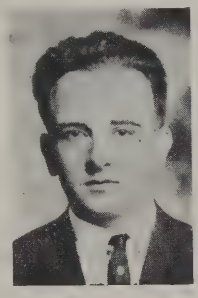
Just previous to the accident Munroe received an SOS call from another ship and later after sending his own SOS received two more; one from a ship in distress off New York an another from a ship on fire off Maine. The *Currier* was one of four ships in trouble that night.

* * *

Few know that Edwin A. Nicholas, who was recently promoted from the post of superintendent of the Great Lakes Division of the Radio Corporation of America, to assistant to the general manager, once played the role of hero. In January, 1916, his ship the *M. and B. No.* 1, was caught in an ice jam on the lakes. Although a large cake of ice smashed into his room it did not prevent him from using the key.

* * *

HERBERT L. McCENEY, running between New York and France on the *Englatine,* is often referred to as the hero of the sinking of the *Lake Frampton,* a vessel which was rammed and sunk by the *S.S. Comus* early in July, 1920. McCeney owes his life to the fact that he was a good swimmer. He had lost his life belt and the boats had cleared by the time he was ready. It was necessary to run down the side of the vessel, already laying over, and swim fast to get away from the suction. He was picked up on the opposite side of the *Comus* and for some time was thought missing.



Information Desk

(*Continued from page* 76)

Mr. Jacob Anderson, Los Angeles, California.—Will you please tell me how a resistance coupled amplifier works? It is apparent to us B.C.L.'s how a transformer will step up a given voltage. But the resistance amplifier is a mystery.

First of all in a resistance coupled amplifier there is a resistance of about 100,000 ohms placed in the plate circuit of the first tube. The variation of the plate current flowing through this resistance causes a variable voltage drop across it, which is impressed on the grid of the next tube, by means of the coupling condenser which may be .002 mfd. or thereabouts. This coupling condenser serves to prevent the grid of the next tube from operating at the normal D.C. positive plate voltage and permits its operating at the most favorable point on its own characteristic curve. This is the second tube we are speaking of now. Then to prevent this condenser from assuming too much of a charge and "blocking" we insert between the grid of the second tube and the filament an ordinary grid leak. This grid leak allows part of the charge to leak off so much at a time and prevents the "blocking" of the tube. In a resistance coupled amplifier the plate voltage required is generally much higher than that of a transformer coupled amplifier. This will be at once seen when one stops to consider the resistance inserted between the source of supply and the plate. A resistance coupled amplifier when working properly is absolutely distortion proof and forms an ideal amplifier. Resistance coupled amplifiers are treated very thoroughly in Mr. Frank's article on Amplifiers running in this and the two preceding numbers.

Mr. S. H. Newell.—I am writing you to find out what the characteristic curve and amplification curve of a tube mean. I have seen this repeatedly in radio magazines and no attempt to explain it has been given.

We refer you to the answer to J. Anderson's question.

Ernest A. Reynolds, Monroeville, Indiana.—Is there any device which can be substituted for my "A" and "B" battery which will eliminate the trouble of purchasing new ones and having them recharged?

Such a device was presented recently at a luncheon of radio editors at the Hotel Pennsylvania by the Sabin Electrical Products Corp. of Jersey City, N. J. This instrument incorporates both "A" and "B" batteries. A model is also made for just the "A" batteries. This consists of a thermo-couple device which includes the transformation of electrical energy supplied by your house mains into heat then the transfer of heat to another thermo element which in turn produces the six volts or the 45 to 90 as may be required.. At the tests where the instrument was used with alternating current there was absolutely no hum noticeable when used with a sensitive radio frequency set. The substitution was made of dry cells for the thermo instrument and no change was observed in the character of the signals nor their audibility. Further information on this instrument may be obtained from the above manufacturer.

Rafael Bordenave, Havana, Cuba.—Some of the intermediate frequency transformers now on the market are sharply tuned to 3,000 meters, others to 6,000, others to 8,500 and some to 10,000 meters. Some of these have air core, others iron core. Which is the most efficient type to use for my purposes?

The 10,000 meter iron core shielded will probably be found best for your purposes. The shielded type permits closer mounting than the unshielded and provides a more stable amplifier. The higher you go in wavelength, the lower you go in frequency and the lower the frequency the greater the amplification. The input transformer or filter can be made by using two 1,500-turn honeycomb coils with their windings shunted by .0005 fixed micadon condensers. These two honeycomb coils should be mounted three or four inches apart and this distance made greater if the set tunes too broadly.

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Mr. A. Zumwalt, Durant, Oklahoma.—In your May issue of THE WIRELESS AGE you showed a new superdyne. I would like to know where I can get complete blue prints of this circuit and where the curkoid coils are manufactured.

The blue prints for this circuit may be obtained from the C. D. Tuska Co., Hartford, Conn., together with parts. The curkoids may be obtained from the Rieger Research Laboratories, 100 Charles Street, New York City.

J. E. Eckles.—Is there any way of determining what the proper charging rate of a storage battery is when used for lighting a UV-200 and 2 UV-201A's? My battery is a 3LxL9.

There is no particular way of determining just what your charging rate should be and most makes of chargers on the market today do not have a variable charging rate. The type of battery which you have has a 100 ampere-hour capacity and its manufacturers recommend that it be charged at six amperes until nearly up to charge and then reduced to three amperes. The slower the charge the better for the battery. Be sure that your battery is filled with water before starting the charge. A very good charging arrangement was shown in Mr. Ward's article in the May issue of THE WIRELESS AGE.

H. M. Nestor, Dayton, Ohio.—In accordance with the article in the February issue of THE WIRELESS AGE I made up one of your three-tube sets, one stage of tuned radio frequency crystal detector and two stages of audio frequency. I cannot make the set oscillate and the tuning is very broad.

The reason the set will not oscillate is that the crystal detector is not doing its share of the work. As we outlined in the May issue a good adjustable crystal is superior in this particular case to a fixed one. The fixed ones at best are none too good for this purpose, and a rough surface mineral will in general be more satisfactory than a smooth one. The reason your set tunes so broadly is the fact that your radio frequency tube is doing the detecting instead of your crystal and since it is not functioning as it should what results you have obtained have been obtained in spite of your set and not because of it.

J. E. Taylor, Columbus, Ohio.—In experimenting with different radio sets, I have had occasion to wind numerous coils of inductance. I would like to know if there is any given ratio between the number of turns or the length of the winding and the diameter. It seems to me that a certain ratio should be the most efficient.

This ratio as given by Professor Morecroft is as follows: The maximum inductance for a given length of wire is had when the diameter is 2.45 times the length of the coil. This represents the ideal inductance, but can be varied to an appreciable extent without a serious loss in efficiency. An example of the above formula is as follows: a coil of wire 5 inches in diameter would have the maximum inductance if it was wound in a space 2 inches long or 5 inches equals 2.45x2 inches.

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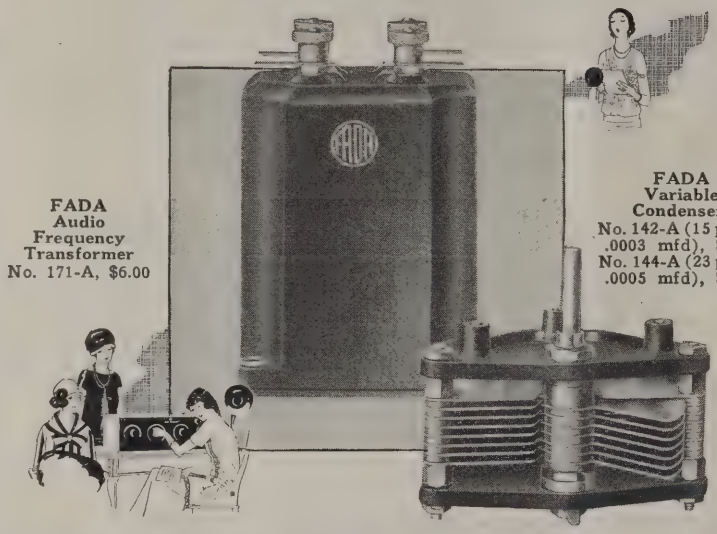

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POOR condensers absorb radio power—that cuts down volume. Poor condensers add resistance—that broadens tuning. You can sharpen your tuning, increase selectivity and get greater volume with the new FADA "low-loss" variable condensers. Use them. The low power factor and low equivalent series resistance prove their superiority. FADA "low-loss" condensers are more efficient than many of the so-called precision condensers and have a capacity ratio of 40 to 1 as compared with 30 to 1 which is usually encountered. Two sizes—No. 142-A (15-plate .0003 mfd) at $3.00 and No. 144-A (23-plate .0005 mfd) at $3.50.

Performs as well as it looks

The new FADA Audio Frequency Transformer is encased in bakelite with nickeled binding posts and soldering lugs. It looks "quality" all over. And it performs up to its appearance. It has a high average amplification over all the broadcasting wave-bands and reproduces voice and music with a volume and tonal fidelity that is surprising. A wonderful addition to the audio frequency stages of Neutrodyne receivers and equally efficient in other types. This new transformer, No. 171-A, is made possible by correct FADA engineering principles and by uniform production methods. Ratio 4 to 1. Price $6.00.

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Transradio

(*Continued from page* 29)

which forks halfway along, twelve pairs going to Villa Elisa and six to Monte Grande. In the central office, in the midst of the rococo-fronted bank and office buildings of Buenos Aires are situated the controls that launch into space the 500 kilowatts from the transmitter, and here too the speeding wave-fronts from Europe and North America finally reach their journey's end. According to conditions, both head-phones and automatic ink-receivers are used for reception. All northbound traffic is sent by means of perforators and automatic transmitters.

The tumult and the shouting connected with the first few months of service have died away, and throughout Transradio things have settled down to normalcy in the economic, efficient and accurate handling of commercial traffic. Obstacles still exist, it is true—many of them—but the personnel from the highest to the lowest are already possessed of that *esprit* bred of having accomplished things, and its existence always means that still greater progress lies just ahead. Argentina, the first South American country to establish high-power commercial service, has her hat in the ring, and it is there to stay.

Scouts Who Have Made Good in Radio

(*Continued from page* 25)

heard radio-equipped airplanes racing toward Norfolk and exchanging messages with the Naval Air Station at Anacostia.

The following winter he was once more the operator at the scout camp, this time at Cold Spring. Again his receiving outfit was the only means of securing up-to-date news. Using a vacuum tube receiver, he copied the amateur broadcasts, and the national office could reach him with broadcasts transmitted by NAH, the Navy station at New York, which has been transmitting official scout messages for a number of years. The weather reports that he received and posted were of considerable value to the winter campers.

In July, 1922, Barry went with Manhattan Troop 503 to their summer camp at Redding, Connecticut. He was in charge of the camp. He carried a radio set with a two-stage amplifier. Every night he copied such information from Government stations as was of value to the people of the community, and every morning he sent an orderly to post the weather report and other items in the village post-office. It

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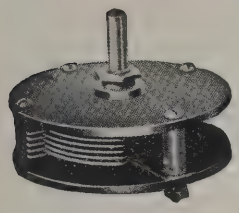

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(audio frequency)

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"Simplest thing in the world, Mary. The boys at the office have been talking Thordarson Amplifying Transformers so hard that I decided to install them in place of my old ones. I see now that it was a wise move."

* * *

The Super Transformer is indeed the mirror of the Broadcasting Studio. It was designed with one primal aim—perfect reproduction. It has the same function in a radio set that the reproducer has on your phonograph. Install a pair—it will take you but a few minutes—and you will marvel at the rich musical quality obtained.

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happened that the weather for the two weeks was almost exactly what the forecasts predicted, and Barry was soon considered a wizard at radio.

After having progressed through the various degrees of scoutcraft, Barry became a scoutmaster. His scouts, naturally, became interested in radio. Nine of them in one year made their own receiving sets, and four of the sets were good tube outfits. Several meetings were held for special instruction in radio. When they went on a hike they always carried one receiver, at least, and by stringing an aerial from a tree they kept in touch with the world.

One member of the troop is now an operator at WBZ, the big Westinghouse broadcasting station at Springfield, Massachusetts. Another made an extended trip to Europe, where he was saluted and greeted by scouts and scout officials in many countries. He reported that even the shopkeepers recognized the scout badge and respected it. Still another of Barry's scouts worked his way on a ship to Sweden, the birthplace of his parents, and from there made a tour of Europe alone.

Last year Scoutmaster Barry took unto himself a wife. Of course, he married the nicest girl in the world, for all such a good scout has to do is to have the line form on the right and take his choice. Under similar conditions some scout officials have found less and less time for scouting; but Mrs. Barry is too good a scout herself to deprive her husband's scouts of his leadership. Instead, she pitches in and works as hard as any assistant scoutmaster.

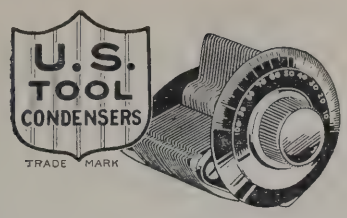
Beside attending to business and keeping the scout work going, Barry keeps up with the correspondence courses conducted by the Army for its officers. He received 86% in the examination in administration and 100% on organization of the Army. He is in command of the 2d Platoon, Company I, 307th Infantry, 77th Division.

Aside from an armful of merit badges, Scoutmaster Barry now has a ten-year veteran's badge; but this is what he says:

"It seems a long time since I first passed my tenderfoot test. As I look back on it, I think I cared more for that badge than I did for almost all the rest."

But suppose Scout Barry had stopped after he had won his tenderfoot badge. Would there have been as much pleasure in looking back after ten years and realizing that he had made no further progress in all that time?

What are you, who read this account of a remarkable scout career, going to look back at ten years from now?



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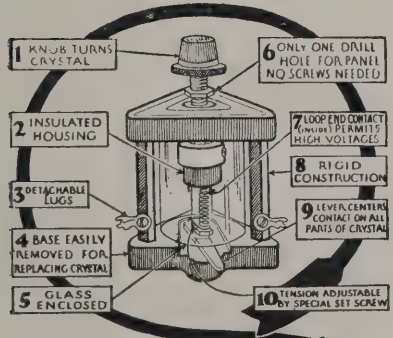
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THE skill and painstaking care maintained provide a balance comparable, figuratively, with the poise of the soaring eagle. Demands upon quantity production are forgotten in the untiring effort to provide the perfect balance of tube capacities that has made the Eagle the peer of Neutrodynes.

Eagle Neutrodyne cannot reradiate nor regenerate. Its remarkable ease of operation makes certain the reception of any station, once logged. As wonderful in simplicity as the phonograph; more wonderful in its volume—clear, loud, actual in tone.

QUALITY FIRST characterizes the Eagle—and prompts the unreserved guarantee.

We Soar Above

EAGLE RADIO COMPANY
24 BOYDEN PLACE **NEWARK, N. J.**

Give Your Loud Speaker To the Ash Man

The **Rhamstine* Needlephone** has made the conventional loud speaker as out of date as a single circuit blooper. It sets a new standard, which no radio loud speaker has been able to meet.

It eliminates mechanical noises by removing the cause. It has no diaphragm, so cannot produce metallic sounds. Its limitations are only those of your receiving set.

Utilizes Phonograph Perfection

Everyone recognizes the perfection of the present day phonograph as an amplifier. The correctly proportioned tone-arm, the wood tone chamber contribute to this; but the greatest single factor is the mica reproducer.

Only the **Rhamstine* Needlephone** can bring the clarity, mellowness and cello-like beauty of tone of the phonograph to the radio, because it alone uses the phonograph reproducer.

It is not an attachment—not an adapter. There is nothing to change on your phonograph. The illustration shows how it operates. For any phonograph except Edison without Victor attachment.

Money-Back Guarantee

Don't take anyone's word for it. Try it out. Test it beside the loud speaker you think best. Compare tone volume, convenience, with any loud speaker at any price. See for yourself how much noise the diaphragm is to blame for.

You take no risk. If it isn't all—and more—than claimed, return it. Your money will be cheerfully refunded. Don't be content with less than **Needlephone** perfection. Send the coupon today.

$10 Complete with Cord

RHAMSTINE*
Needlephone

Transfers the electrical energy of your radio into vibrations which, through the phonograph needle, are transmitted to the reproducer of your phonograph. It makes your phonograph the world's finest loud speaker.

The same high quality as Rhamstine* Transformers, Victophone and Electric Soldering Iron.

If your dealer hasn't Rhamstine* Products, send for details and prices.

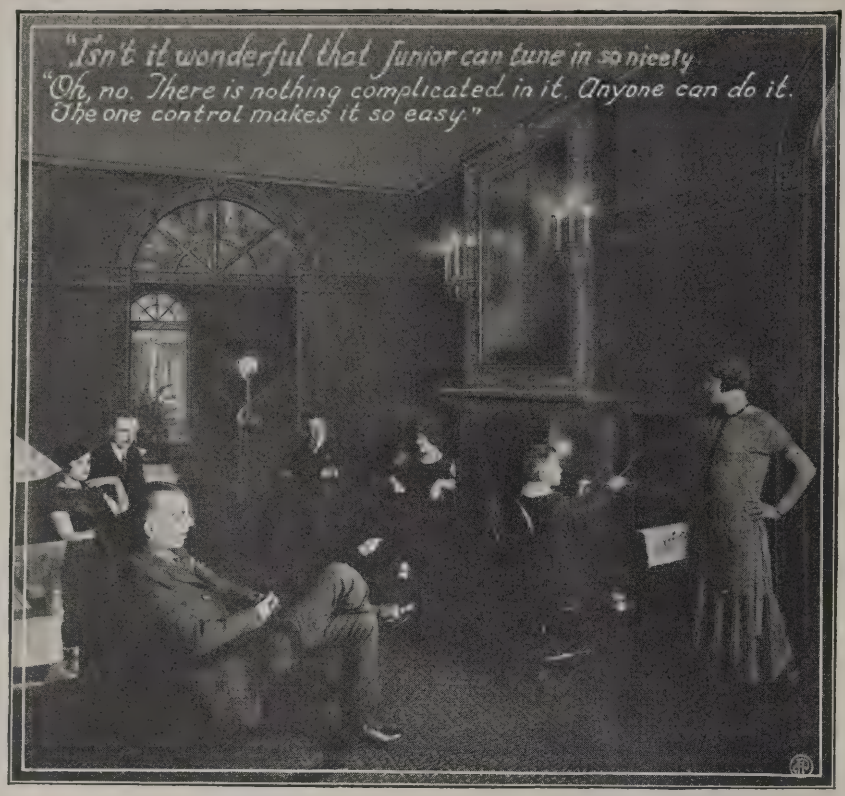
J. THOS. RHAMSTINE*
504 E. Woodbridge, Detroit, Michigan

Send me the **Needlephone.** I'll pay the postman $10 upon its arrival. It is distinctly understood I may return it if I desire, within 5 days and receive a refund in full.

Name .....

Address .....

*Radio and Electrical Products.


"Isn't it wonderful that Junior can tune in so nicely
"Oh, no. There is nothing complicated in it. Anyone can do it.
The one control makes it so easy."

Bristol Single Control Radio Receiver

Complicated combinations are eliminated when tuning in with Bristol Single Control Radio Receiver —every station is on the one dial. It gives the joys of radio with technicalities left out.

The well-known Grimes Inverse Duplex System (non-reradiating) is utilized in this Receiving Set. Because of the reflex, only four tubes are required to give power equivalent to six. The price, without accessories, $190.00.

AUDIOPHONE Loud Speaker

You forget the radio equipment when listening thru the Audiophone Loud Speaker. The tone is full, clear and pleasing. It gives a true reproduction of the original. Made in three models—Senior $30.00, Junior $22.50, and Baby $12.50.

Ask for Bulletins Nos. 3014 and 3015-V.

Made and Sold by

THE BRISTOL COMPANY
WATERBURY CONNECTICUT

Built up to a high standard, not down to a low price

CARTER Portable Jack

Just the thing to use for extending the loud speaker into the hall, onto the porch or out into the garden, without moving the set. Takes any standard plug.

Portable Jack $1.50
Carter quality throughout
ANY DEALER CAN SUPPLY

Carter Radio Co.
1802 REPUBLIC BUILDING
CHICAGO

The Wireless Age Portable Reflex

(*Continued from page* 49)

as near to where you wish the set to be placed as possible, and run the other end in the direction away from which you wish to receive the most stations. That is if you are located on Long Island and wish to receive the New York stations you will erect the antenna so that its free end is pointed east and the set is located on the west end. This will give your antenna a westerly direction effect and will prove most efficient in that direction. When you are ready to pack up and come home, simply wind the wire back on the spool and it will not take up more than the space of a kodak in your suitcase.

It is altogether impractical to use an immense loud speaker for use with this set. In the first place they are in general, awkward to handle and will not pack well. The best we have found in this line is a single sensitive phone unit in connection with an ordinary 10-inch by 12-inch hand megaphone such as the one we used to use when we saw a 60-yard run for a touch-down, through a broken field. We fastened the phone unit onto the mouth piece of the megaphone with friction tape. It will be found that a few turns of this tape will hold the instrument together surprisingly well. Of course as it stands now it has no support and is not very efficient. A broom handle stuck upright into the ground near the camp will fill the bill great. Use some more of the friction

(*Continued on page* 90)

Antennas and Grounds

(*Continued from page* 52)

The grounding conductor may be run either inside or outside the building. The protective grounding conductor and ground, installed as prescribed in the preceding paragraphs may be used as the operating ground. It is recommended that in this case the operating grounding conductor be connected to the ground terminal of the protective device.

If desired, a separate operating grounding connection and ground may be used, the grounding conductor being either bare or provided with an insulating covering.

WIRING

Wires inside buildings shall be securely fastened in a workmanlike manner and shall not come nearer than 2 inches to any electric light or power wire not in conduit unless separated therefrom by some continuous and firmly fixed non-conductor, such as porcelain tubes or approved flexible tubing, making a permanent separation.

NO MORE CABINETS

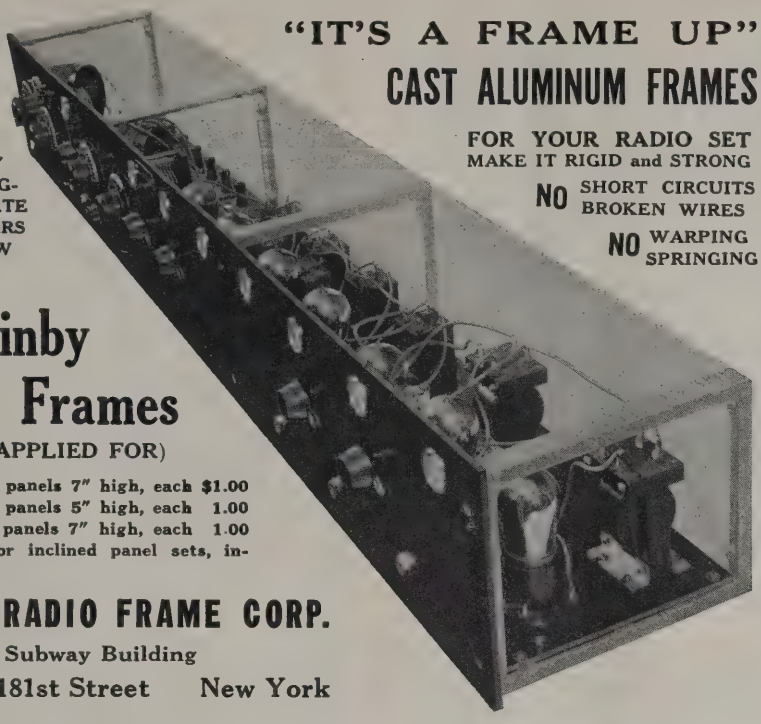
"IT'S A FRAME UP"
CAST ALUMINUM FRAMES

FOR YOUR RADIO SET
MAKE IT RIGID and STRONG

NO SHORT CIRCUITS
BROKEN WIRES

NO WARPING
SPRINGING

JUST APPLY FLAT MAHOGANY OR PLATE GLASS COVERS TO THE NEW



Quinby Radio Frames

(PATENT APPLIED FOR)

SIZE "A" for panels 7" high, each $1.00
SIZE "B" for panels 5" high, each 1.00
SIZE "C" for panels 7" high, each 1.00
(SIZE "K" for inclined panel sets, inquire)

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Subway Building
587 West 181st Street New York

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If you have the January, February, March, April, August, October, 1923, copies of THE WIRELESS AGE send them to us and we will extend your subscription one month for each issue.

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THE WIRELESS AGE
326 BROADWAY NEW YORK CITY

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Advertising Director of Westinghouse Co.
says:—

"More people listen in to religious services than to any other feature on the radio program."

You can reach this market through
CHRISTIAN HERALD

Guglielmo Marconi, as he appears today. Signor Marconi is Honorary Chairman of the Radio Institute of America

Train for the big Jobs in Radio

There are big radio jobs waiting. Over 6,000 operators have already graduated from the Radio Institute of America. But the radio industry is just in its infancy. There are more demands for operators than there are trained men to meet the demand.

Conducted by the Radio Corporation of America, the Radio Institute offers the soundest instruction and the most logical means of employment after graduation. Write for information concerning our classes.

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Conducted from New York City. Full instruction for those who cannot attend the San Francisco resident school.

A. *Complete* Home Study Course. From beginnings of magnetism through code and commercial practice. Prepares you for U. S. operator's license.

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(*formerly Marconi Institute*)
Established 1909

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HOME STUDY DIVISION
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Please send me full information about radio opportunities today, and your
COMPLETE RADIO COURSE ☐
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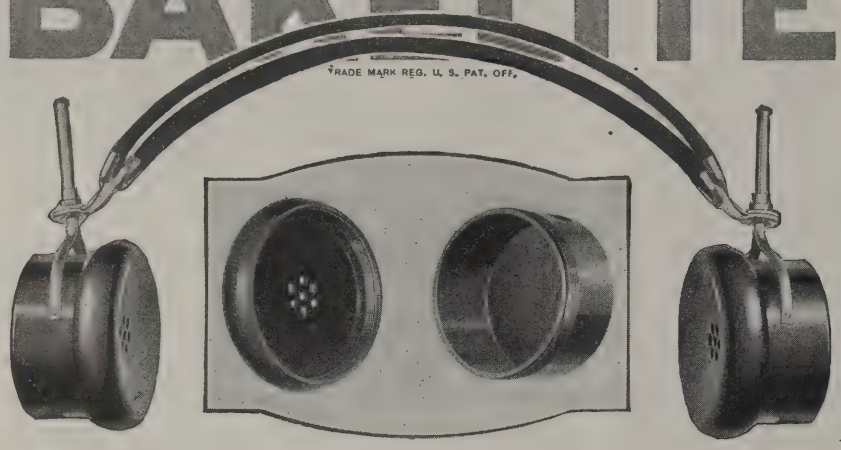
BAKELITE

TRADE MARK REG. U. S. PAT. OFF.



Baldwin *and* Bakelite

The clear tone of this popular headset, made by Nathaniel Baldwin, Inc., of Salt Lake City, has been developed by careful experimentation in every phase of its manufacture, from the selection of raw materials to the final testing of the completed instrument.

Bakelite is used for the receivers because it is strong, and light in weight. After years of service under varying atmospheric conditions, Bakelite shows no signs of deterioration. Its color does not fade and its fine finish is impervious to oils, acids and moisture.

"The Material of a Thousand Uses" possesses many valuable properties which make it peculiarly suitable for use in radio equipment.

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REDMANOL
are the registered Trade Marks for the Phenol Resin Products manufactured under patents owned by
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Send for our Radio Map

The Bakelite Radio Map lists the call letters, wave length and location of every broadcasting station in the world. Enclose 10 cents to cover the cost and we will send you this map. Address Map Department.

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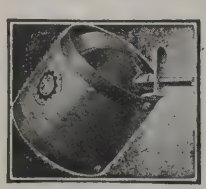
247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22d Street

THE MATERIAL OF A THOUSAND USES

—PALL MALL PRODUCTS—



Pall Mall 180° Variocoupler, Pall Mall Variometer, tune 150-650 meters. Small - wound with Green Silk Wire. Pall Mall Products make a good set better. List Price $2.00 each. Jobbers, Dealers write for discounts.

ESSEX MFG. CO.
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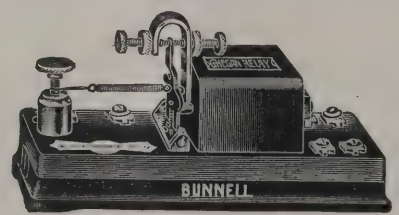
GHEGAN RADIO RELAY



Taps permit tubes of various impedances to be used. With Bunnell Register this Relay will copy telegraphic signals at a speed of 60 to 90 words per minute. With Siphon Recorder speeds up to 200 words per minute have been obtained. Normal operating current is ½ to 2 milliamperes. Send stamp for catalogue No. 45 W.

Ghegan Radio Relay.....$40.00
Special Price to Dealers
J. H. BUNNELL & CO. 32 Park Place, New York City

Sound

(*Continued from page* 35)

is so great as to cause pain in the ear. This is also shown in the upper curve of the accompanying figure, 4, and is seen to vary with the pitch of the sound.

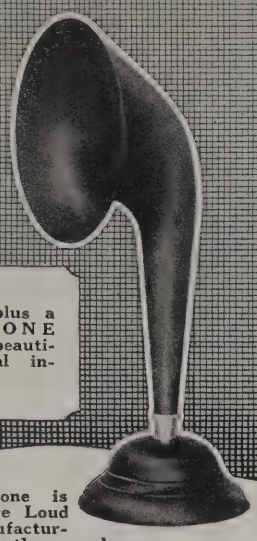
5. Between the lower and upper pitch sensation limits and the upper and lower intensity limits is a region known as the auditory sensation region. This region roughly covers all pitches from about 20 to 20,000 cycles and pressure changes from about 0.0008 dynes to about 8,000 dynes, or a range in sound pressure of 100 million times the minimum pressures required for audition. This range in sound pressure corresponds to a change in the sound energy or intensity of 10,000 trillion times the minimum audible intensity. These numbers are far more awe-inspiring than were the calculations of the dollar in terms of German marks! It simply shows that the range of usefulness of the ear in every day use is astounding.

6. At any one pitch the ear can detect a number of different intensity increments. That is, if the intensity is some given value, then when it is suddenly increased to a slightly greater value the ear can detect the increased loudness. The ear has the power, therefore, of loudness discrimination. At low frequencies the increase in intensity needs to be greater than at the higher frequencies. Also at weak intensities the increase in intensity needs to be greater than at higher intensities, figure 5 shows this characteristic. For example, at intensities near the lower intensity limit of audition the intensity has to be increased about 25 per cent. in order to detect a change in loudness, whereas at normal intensity the increase needs to be about 10 per cent. In the figure, for example, 10^4 means 10,000 times the minimum audible intensity, 10^8 is 100,000,000 times, etc.

7. We find also that the ear possesses the power of pitch discrimination as illustrated in the accompanying figure 6. At low frequencies the ear can detect a difference in pitch of about one per cent. in the neighborhood of fifty complete vibrations. From 500 to 5,000 cycles the ear can detect difference in frequency of about 0.3 per cent.; that is, at 50 cycles, the ear can detect a change in pitch of 50.5 cycles, at 1,000 cycles it can detect a change of 3 cycles, etc., at high frequency the percentage has increased again.

8. If we take into account upper and lower frequency limits of auditory sensations, the minimum audible sound intensity, the maximum pressure changes which cause pain and the ability of the ear to detect changes in intensity and pitch of a single tone, we

$8.00



A phone plus a FIBERTONE makes a beautiful musical instrument.

The Fibertone is used by more Loud Speaker Manufacturers than any other one horn. It follows that these manufacturers have made scientific tests and find Fiber to be best for true tonal reproduction. This is a significant endorsement to those who want the best reproduction for the least investment. The base is designed to fit the phone from any head set. Use your own unit which you know is good. If your dealer cannot supply you, write to us direct.

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36 Orange Street Bloomfield, N. J.

FIBERTONE
RADIO HORN

Music Master Corporation
10th & Cherry Sts. Philadelphia
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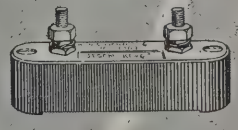
Special service to dealers on Radio Corporation of America products in Pennsylvania, New Jersey, Delaware, Maryland, District of Columbia, Virginia, West Virginia and Ohio.

Radio Safeguards

STORM KING LIGHTNING ARRESTER

Approved by the National Board of Fire Underwriters



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Solders All Joints Permanently.

SOLDERALL CO.
NEWARK, N.J.

New!

FIL-KO-STAT
SCIENTIFICALLY CORRECT RADIO RHEOSTAT

with Battery Switch Attached

$2.00 AT YOUR DEALER

at no extra cost. Still $2.00. Still the filament control of proven supremacy. *The only rheostat and battery switch in one.* If you want perfect control of any type tube in any hook-up—if you want DX stations you never heard before—if you want silent tube operation—maximum signal regeneration--longer tube and battery life--then you *must* use FIL-KO-STAT, *the Filament Control of Infinite Adjustment.* The Battery switch (patent applied for) attaches to regular mounting screws. No extra holes to drill.

Write for a free copy of our new booklet "Improved Reception Through Scientific Tube Tuning"

New!

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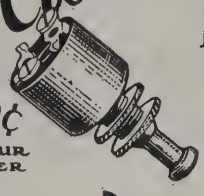
SCIENTIFICALLY CORRECT
Simple-Sturdy-Sure

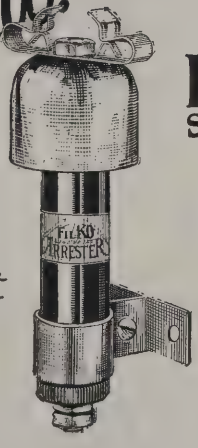


50¢ AT YOUR DEALER

A necessity on any radio set. *"Current on or off at the touch of your finger."* It takes minimum space both on the panel and behind it. The single-hole mounting makes it easy to attach. Fitted with double connections—connect wires to the terminal screws or to the solder lugs. Sturdy interior members give positive contact. Metal parts heavily nickeled.

New!

FIL-KO-A LIGHTNING ARRESTER
SCIENTIFICALLY CORRECT
Prevents Leakage Losses



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This arrester with its bell-shaped shield will positively keep dry and not gather dust or other conductive matter which causes short-circuits from aerial to ground. This makes certain that all radio impulses reaching the aerial pass through your set, insuring maximum reception. Insulation is of polished Bakelite—the best, most moisture-proof dielectric. It is hermetically sealed—no dirt or moisture can reach the gap. Rugged mounting bracket keeps FIL-KO-Lightning Arrester rigid under all conditions.

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By ELMER E. BUCHER
The best text book on the market devoted solely to the various applications of the Oscillation Valve
Price, see page 6
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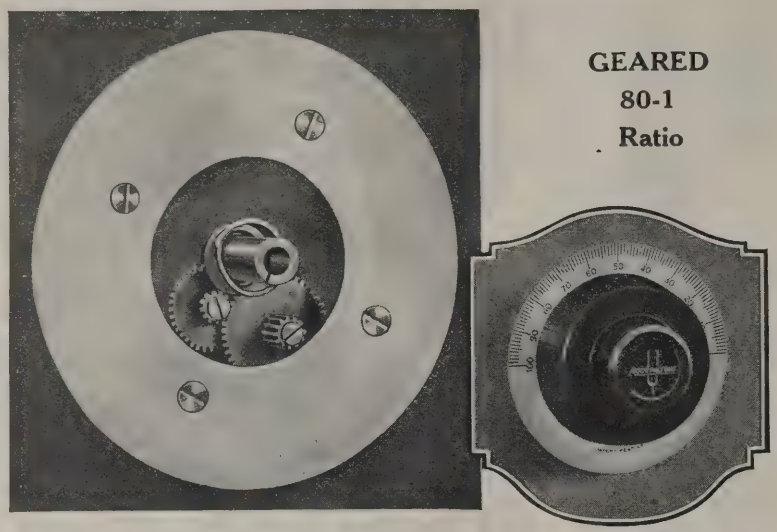

GEARED
80-1
Ratio

New Improved Accuratune

Eliminates Panel Drilling

The new Accuratune Tuning Control mounts flush with the panel—installed on all standard condenser shafts with the ease of an ordinary dial.

The operating mechanism is designed to give infinite tuning precision—geared to develop 80 to 1 ratio. This means the micrometer knob must be turned eighty times to secure the usual functioning revolution of an ordinary dial.

This accounts for the unusual tuning efficiency of Accuratune Micrometer Controls and their ease of operation. Ten times more accurate than vernier condensers or any tuning device. Stations you never heard before are tuned in clearly. Designed for both coarse and precise tuning. Guaranteed.

The tuning satisfaction and the results secured with Accuratunes repay for the slight additional cost over ordinary dials. Price each, $3.50. At your dealers—otherwise send purchase price and you will be supplied postpaid.

ACCURATUNE
Phonograph Attachment
Attaches instantly to the reproducing arm and converts your phonograph into a loud speaker. Permits the whole family to enjoy broadcast music.
$10.00

MYDAR RADIO COMPANY
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ACCURATUNE

80-1
MICROMETER CONTROLS

RED-HEAD PHONES

Used and Praised the World Over

3000 Ohm, $6.50. 2000 Ohm, $5.00
Complete with Cord and Headband.

At your dealer's, or sent direct.

THE NEWMAN-STERN CO.
Newman-Stern Bldg. Cleveland

A RADIO SENSATION

Patent Applied For

A tuner that works without "B" batteries. Something new. Reliable, Portable, Fool-proof and a hook-up that will revolutionize the art. It positively does not re-radiate and works with loop or aerial. Works loud speaker with one tube on local signals.

Circulars two cents

TRESCO SALES, INC.
DAVENPORT IOWA

find that the normal ear can detect the enormous number of over 300,000 separate tone sensations. That is, the area between the two curves of upper and lower intensity limits can be divided into over 300,000 little rectangular areas within each of which constitutes a single tone which can be distinguished from the tones in all the remaining areas. It seems to me, then, when we grasp the full significance of these numbers we can then appreciate the wonderful performance of the human ear when called upon to analyze the beautiful combination of complex sounds which exist in the realm of music.

Reference may be made to the following treatises by Dr. J. P. Minton for a more comprehensive study of the characteristics of the ear:

"Physical Characteristics of Normal and Abnormal Ears," The Physical Review, February, 1922.

"The Sensitivity of Normal and Defective Ears for Tones of Various Frequencies," Proceedings Institute of Medicine, Chicago, 1921.

"Some Physical Characteristics of the Ear," Proceedings National Academy Sciences, August, 1921.

"Some Cases of Nerve-Deafness and Their Bearing on Resonance Theory of Audition," Proceedings National Academy Sciences, September, 1922.

"Correlation Between Physical and Medical Findings on Normal Ears," Proceedings National Academy Sciences, August, 1923.

"Physical Measurements of Minimum Audibility," The Journal of Laryngology and Otology, England, August, 1923.

"Tinnitus and Its Relation to Nerve-Deafness with an Application to the Masking Effect of Pure Tones," The Physical Review, November, 1923.

Approved Portable Receiver

(*Continued from page 39*)

line and on the A.F. amplifiers to the negative terminal of the filament heating supply.

It should be noted that only three battery leads are necessary; two are for the 4½-volt filament battery and the other is the positive plate battery connection. The negative "B" and positive "A" are joined together. No tap is used for the detector plate as with 70 volts plate battery the UV-199 works quite well.

Control is through the condenser vernier, the knob for which protrudes through the suitcase under the handle; the potentiometer or volume regulator is seen mounted to the left of the condenser vernier.

Two 12-ohm rheostats are shown in the photograph, but one 20-ohm rheostat will suffice.

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This organization was one of the pioneer wholesale distributors of radio equipment. They have seen hundreds of retailers come and go—they know from experience "what and when and how" dealers can best sell radio supplies and enjoy a satisfactory margin of profit.

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THE ACOUSTICAL AMPLIFIER

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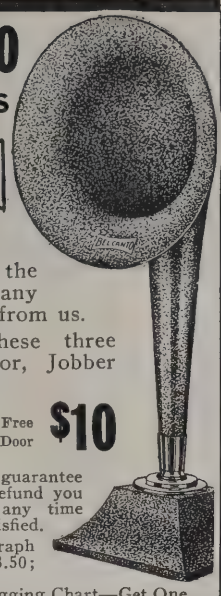

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You cannot buy the Bel-Canto through any dealer, only direct from us.

We save you these three profits — Distributor, Jobber and Dealer.

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Adjustable Phonograph Loud Speaking Unit $3.50; Delivered Free..

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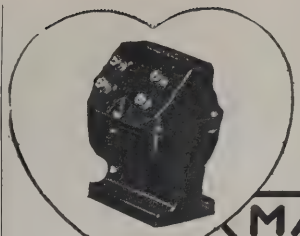
General Office and Factory: Dept. W. A.

417-419-421 E. 34th Street New York City

Telephone, Vanderbilt 8959



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Radio & Audio Frequency

TRANSFORMERS

"The Heart of a Good Receiver"

Your dealer will tell you why Marle Transformers do not howl or distort. Uniform amplification up to as many as 3,500 cycles.

MARLE ENGINEERING CO.

ORANGE, NEW JERSEY

LEARN THE CODE BY THE

Marconi-Victor Method

You Just Listen and Learn

MARCONI VICTOR COURSE IN WIRELESS TELEGRAPHY
It's just as interesting to read the dots and dashes as to listen to broadcasting. These records will teach you quickly, under actual operating conditions, to read code at a speedy rate.
Victor

Six Double-Faced Marconi Victor Records, with instruction Manual **$5.00**

WIRELESS PRESS, Inc.

Room 405

326 BROADWAY NEW YORK

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6½-Ohm Rheostat $1.00
25 Ohm Rheostat $1.10
40 Ohm Rheostat $1.10
Patd. 870,842

HOWARD

No. 1003
200 Ohm Potentiometer ...$1.50
400 Ohm Potentiometer ...$2.00
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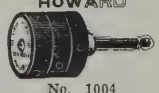
HOWARD



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Multi Terminal Receiver Plug. Instantaneous connection for as many as six pairs of standard receiver plugs.....$2.00
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6¾ Ohm Micrometer Rheostat $1.50
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Jobbers write for discounts.

Send 2c stamp for wiring diagram and folder.

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Radio Co. Inc. 4248 N. Western Ave.

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Practical Wireless Telegraphy

By ELMER E. BUCHER

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See page 6.

WIRELESS PRESS

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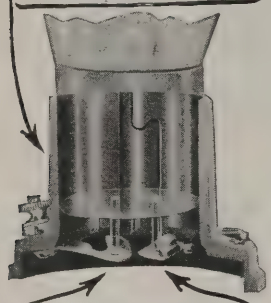
UNIFORM CROSS SECTION OF THE NA-ALD DE LUXE SOCKET



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THIS ILLUSTRATION SHOWS HOW THE CONTACT STRIPS CAN BE MADE TO CLEAN TUBE TERMINALS AUTOMATICALLY BY ROTATING TUBE SEVERAL TIMES.

Look for the socket board

In leading radio stores you will find the Na-ald Socket Board, displaying the five standard Na-ald Sockets. For the 200 and 201 tubes, the De Luxe at 75c, and also the Small Space at 35c: For the UV-199, No. 499 at 50c and adapter at 75c: For W. D. 11, No. 411 at 75c.

Ask your dealer to show you the self-cleaning arrangement of contacts in Na-ald De Luxe, No. 400. These dual-pressure contact strips cut into the sides of tube terminals, keeping their surface clean and bright, and resulting in perfect contact.

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JACKSONVILLE, FLORIDA
P.O. BOX 378

March 7th, 1924.

The Electric Specialty Co.,
Stamford, Conn.

Gentlemen:

You will be interested to hear of the results obtained from the type 11-A 1000 volt, 300 watt motor generator set purchased from you thru the Chase Co. Jacksonville.

This little generator operating at Radio 4XE, has furnished the plate current for 2-way communication with amateur stations in Canada, Porto Rico, France and Holland. When you consider that such a distance of over 5000 miles can be spanned with a power supply of actually 330 watts, (10% overload) and that this motor generator set does the work in first class manner, it seems quite remarkable.

We believe the Esco generator to be the best and most conservatively rated of any we have used to date.

You may use this letter if you please.

Yours truly,

Cooper and Lee
Owners of Experimental Station 4XE
By

WJL/MP

TRADE "ESCO" MARK
Quality always Supreme
ELECTRIC SPECIALTY COMPANY
STAMFORD, CONN., U. S. A.

Wireless Age Portable Reflex

(*Continued from page* 84)

tape and tape the megaphone and phone against one side of the broom handle and then you are all set. This serves its purpose admirably and is easy to make and handle and very convenient and will not take up much space.

The Operation of the Set

The operation of your receiver is exceedingly simple, there being but two controls if the set is once approximately tuned. The main tuning control is the Cardwell condenser, the coarse tuning being done with the tap switch connected to the primary taps. Do your rough tuning with this tap-switch and then tune in with the variable condenser for maximum results. If the set tunes broadly decrease the coupling between the primary and secondary coils of the vario-coupler by rotating the secondary of the coupler. Move the potentiometer toward the squealing point and leave it just this side of that point. Now your receiver is in its most sensitive condition. The potentiometer adjustment will vary somewhat with the wave length but generally, once set, it will be found to cover quite a range of wave length. The Filkostat should then be adjusted for maximum audibility consistent with the proper temperature of the tube which can be determined with a pocket voltmeter, across the terminals of the socket. This should be three volts. On the whole this will be found a very satisfactory set and we are very much pleased to recommend it to you for your summer's enjoyment.

Radio Activities Broader in Scope

(*Continued from page* 73)

James F. Kerr, General Manager of the First Radio World's Fair, is of the opinion that the huge nude figure can be used to a fine advantage in conjunction with broadcasting, both sending and receiving, and three wireless authorities are now conducting experiments which may result in "Diana" playing a prominent part in the important trans-oceanic and transcontinental tests which are to be staged during the big international exposition in New York, next September, under the supervision of the leading European and American radio scientists.

* * *

A RECENT issuing of patents by the U. S. Patent Bureau clears up a situation that has stopped most radio manufacturers from investing any money in sets containing honeycomb coils or adaptations of the honeycomb space wound principle. For five years litigation between pioneers in the radio industry has been going on. No one

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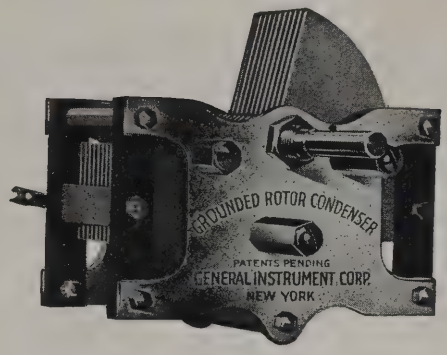

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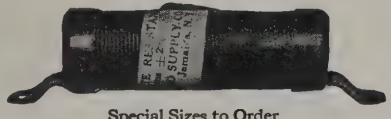

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The Traffic Cop of the Air

He arranges in orderly fashion the mass and jumble of Broadcasting Stations that are seeking entrance to your set and brings 'em in, one at a time, so you can enjoy them! Never reduces, but nearly always increases volume. Add a Ferbend Wave Trap to your set and "Police" your reception. Regulate the Traffic!

Guaranteed to tune out any interfering station. The price is $8.50. Shipment is made parcel post C. O. D. plus a few cents postage. If you prefer, send cash in full with order and we will ship postage prepaid. Send us your order today.

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Improve your set with an AmerTran

And enjoy radio this summer as never before

Send for Circular giving valuable information as to audio transformer design and use.

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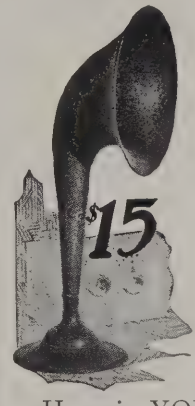
Type AF-6 (Turn ratio 5), has long been acknowledged the Standard of Excellence for audio amplification.
Type AF-7 is now offered for 2nd or 3rd stage amplification with AF-6 for 1st stage. In this use AF-7 decreases the tendency to overload the last amplifying tube on loud signals. Price, either type, $7, at your Dealer's.

American Transformer Company, 179 Emmet St., Newark, N. J.
Designers and builders of radio transformers for over 23 years



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have found that they can own a **Real Loud Speaker Without Cost.** They are earning this Loud Speaker by giving me a few hours a week.

Here is YOUR chance to add a Loud Speaker to your set and let the whole family really enjoy listening in.

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LOUD SPEAKER will reproduce perfectly and with plenty of volume. In fact it is adjustable so the volume can be regulated to your requirements.

A $15 Loud Speaker for only 12 subscriptions. You can earn this in part of your spare time. Besides—
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Burt Evans.

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I want to earn the Perfectone..... Please send me complete information.
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Amateurs can get practically every station on this continent with a one Myers Tube Set. We have records on file to prove it. For instance a New Zealand amateur tuned in Alabama, 10,000 miles on one Myers Tube.

No bunched leads—hence no noise, tube hiss or interference—make

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supreme for clarity of reception of long-distance stations.

Two types: Dry Battery and Universal (for storage battery). Put the world on your dial with Myers Tubes and tune in Canada, England, Havana, Hawaii, Porto Rico, etc., as others are doing. Write for free circuit diagrams.

Insist on the New Improved Myers Tubes—at reliable dealers—otherwise send purchase price and be supplied postpaid.

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About the size of an English Walnut. Saves space; light weight; mounts anywhere; unsurpassed in performance.

Ratios 1 to 3, 1 to 4, 1 to 5, $3.50. 1 to 10, $4.50. Ask your dealer. Send for Bulletin No. 92.

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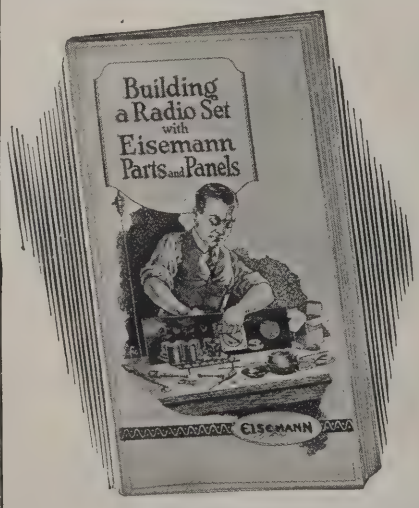


Write for a copy today

A new twenty-four page booklet will be sent, gratis, to those interested in building their own receiving sets.

A simplified method of construction is described. Illustrations and diagrams.

On Request

EISEMANN MAGNETO CORPORATION
WILLIAM N. SHAW, *President*
165 BROADWAY, NEW YORK

has known what the outcome would be. The present owners of the two patents just issued were stopped from even describing their product as honeycomb coils. The wonder then is that the use of honeycombs has become world wide in scope because of sheer merit.

Honeycomb coils were developed during the World War and widely used in the signal services of allied armies and navies. The NC-4 seaplane of the U. S. Navy which first crossed the Atlantic was equipped with radio coils from the Coto-Coil Co. of Providence, Rhode Island, and it is to these pioneer radio coil winders that the honeycomb patents No. 1,490,040 and 1,490,041 are awarded. * * *

AT a recent meeting held in the Hotel Pennsylvania by the New York City Radio Association, the subject of serial numbers on radio receivers was thoroughly discussed. One of the members explained that the number is really the manufacturer's guarantee of the set and its removal makes it impossible to trace inefficient workmanship should the set, for any reason, be returned to the factory; also, the scratched-out number puts the set in a class with damaged and illegitimate merchandise.

Alexander Eisemann of the Freed-Eisemann Radio Corporation said, "So long as the serial number remains on the panel of a receiver the manufacturer's guarantee is binding."

Condensers

(*Continued from page* 51)

charge present upon the condenser we find that half of it is gone through this high resistance path. We then say that this condenser has a high resistance because the result is the same as if we had a high resistance in series with the condenser as per the illustration figure 3 which, though there are four units of energy available only permits two of them to pass to the condenser from which they will later be available for use. When we say that a condenser has low resistance we mean, in so far as relates to leakage of energy is that the condenser has such an excellent insulating medium that the leakage of energy is so slight that the loss is the same as we would have with only a low resistance in series with this condenser. Figure 4 shows the many leakage paths between the rotary and the stationary plates where the condenser uses only end plates made of insulating material as compared to the condenser in Fig. 5, which has metal end plates with only a small leakage path or rather four of them which though shorter than in the case of Fig. 4 have infinitely less surface area in width and as a result less paths over which the energy may flow.

VOLUME 11

THE WIRELESS AGE

"America's Foremost Radio Magazine"

NUMBER 11

Crowds in Cleveland (left) and New York (right) listening in on the Republican and Democratic Conventions broadcast by Western Electric Address System

The Dark Horse on Radio Pike

SHADOWY streamers flitted across the face of the moon, twisted, thinned, then with a swirling backlash utterly engulfed the last vestige of pale light. A black void, still ominous, settled over the stables at the Steepledown Race Course.

Three figures crept into the stall of Black Star, hands groping through the darkness, an occasional whisper stabbing the night like a sudden breeze that has awakened the slumbering voices of a Jack pine. A horse jerked at his halter and snorted.

Black Star, aroused, plunged into the corner of his stall, and stood there quivering. A hand touched his flank. He lunged again. A startled voice cried out, "Quick! Lead him over here! The 'dark' horse is ready to stampede!"

Heavy odds had been placed on Black Star the day before. His showing was bad at the try-out. In the stealth of the night a "dark" horse had been substituted for Black Star. And the dark horse won—won on heavy odds. No one knew of the hoax, other than the culprits. So the dark horse was cheered, and the wagers paid.

And that—we are told—is the origin of the dark horse expression used in politics to-day.

A stately figure stands on the party platform. His hair is streaked with iron-gray. The stern, uprighteous principles of American democracy seem to radiate from the core of his dominant personality. The magnetism of his voice grips the audience and holds it in a high-strung passion of expectancy.

He steps forward, thrusts his clenched fist heavenward, and with a ringing voice denounces the un-American practices harbored in political machines. His audience is held spellbound, breathless. He points to the planks in his party platform, and with genuine emotion, indicates the high principles of self-government contained in each one.

J. N. Darling's idea of a dark horse stampede—N. Y. Herald Tribune

A pause. He leans forward, slightly stooping. His audience responds, and leans forward in anticipation. With a mighty leap into the air he turns a complete back-flop over and beyond the principal of high-principled planks in his party platform. And there he remains.

Those of us who were listening in missed the sylph-like pantomine of this silvery-tongued orator. He was sufficiently athletic to impress all those who beheld, but the logic of his conduct was dissipated in the ether, long before it reached our radio. His presentation of facts was not clear. It was only the presentation of facts that we could assimilate, and failing this, we would only conclude that another "steam-roller" had been launched, and was truly christened in the good old-fashioned way.

With the advent of politics in radio, we are to become familiar with the individual statesman of our country. We will hear the oratorical fire-works of the professional politician, and come to know the depth of his sincerity. We shall hear, for ourselves, the message from an obscure, but conscientious leader of a political body, and judge with impunity the merits of his plea.

This we shall do by radio.

It is difficult to stampede the radio public with a dark horse and then crush the opposition with a steam-roller. Those of us who have listened in, care nothing for the filibustering mechanics of a political meeting, but greet them in the spirit of Blake:

"Mock on, mock on, 'tis all in vain;
You blow the sand against the wind,
And the wind blows it back again."

How Broadcasting June November

Republicanism and Democracy—The Third Conventions—Changing Campaign Tactics the Sidewalks From Wall Street—Than Political Meetings—Looking

As Viewed by

Calvin Coolidge and Charles G. Dawes, Republican candidates for President and Vice President

BROADCASTING the June conventions has accomplished a two-fold purpose. First, it has thrust upon us the mechanics of nominating our executive heads. This is knowledge gained that we have found the more valuable because it has come direct. Secondly, we have acquired a working basis for determining how we shall vote at the November elections. And this is important because knowledge gained is opinion influenced.

Our knowledge was gained direct. Our opinion was influenced direct. This by radio. At the November elections, those of us who have listened in will probably surprise the rest of us. And this because of radio.

REPUBLICANISM is that form of government known as non-monarchical. The Latin Republics scattered about the world are practicable examples. Democracy is that form of government in which the people rule themselves. England is a practicable example of that.

The United States has a combination, or confusion, or what you like, of the two. Republicanism and Democracy

In theory, Republican rule is governmental administration by executives who direct the affairs of state independently of the will of the people. These gentlemen are elected by public poll, and then entrusted with the affairs of government according to the dictates of conscience, experience, and necessity. Actually, the will of the people is held and exercised by the people, through the instrument of recurrent voting. This obviates true Republican rule.

And in theory, Democratic rule is governmental administration by executives who direct the affairs of state only as they have been so directed by those who have elected them. These gentlemen are elected by public poll, and then entrusted with the affairs of government according to the voice of the people. Actually, the will of the people can only be complied with after the echo of public voice has been lost in the clamor of a new demand. This obviates true Democratic rule.

The Republican Party represents rule by an intelligent few. The Democratic Party represents rule by the mass. But theory and practice are still subject to conflicting facts.

Owen D. Young of the General Electric Company makes this very pertinent observation:

"The wide-spread public interest evidenced in the broadcast conventions, indicates that a clear presentation of facts, only, will be countenanced by those who listen in to political speeches. The old method of meaningless oratorical demonstrations, delivered from a platform, will not be of any consequence to a radio audience. This fact will undoubtedly improve the statesmanlike delivery of political speeches to the American people."

AS we become familiar with any one subject, our individual viewpoints change in accordance with our ability to absorb the real, and our competency to cast out the ambiguous. The progressive ratio of opinion influenced may be measured either by our own adroitness in seeking information of reliable character, or by the vehicles of publicity commonly known to influence public opinion. In either case our source of information will have a direct bearing on our final conclusions. Radio is a direct source of information. Broadcasting the June conventions may then be readily accepted as an authoritative source of information bearing on the mechanics of the conventions and the subsequent principles of the political campaigns now in progress. He who has listened in may vote with impunity this coming November.

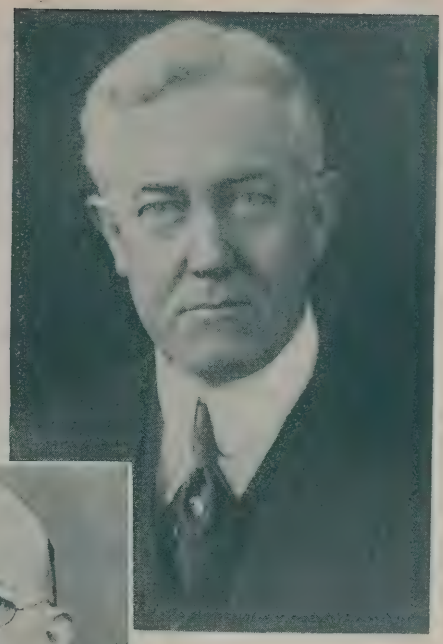
Just what effect radio has had on the third party policies is yet to be ascertained. The Republican Convention in Cleveland was a brief affair, hardly admitting the comprehensive attendance of the radio audience. The Democratic Convention at New York, in direct contrast, stood in the

The G. O. P. elephant blissfully tunes in while—

Conventions Affects the Elections

Party Question—Highlights of the June by Radio—Reaction of the Press—Down Broadcast Reception More Exacting Forward to the November Elections

William A. Hurd



John W. Davis and Charles W. Bryan, Democratic candidates for President and Vice President

glaring limelight for too long a period to escape the searching inquiry of those who listened in.

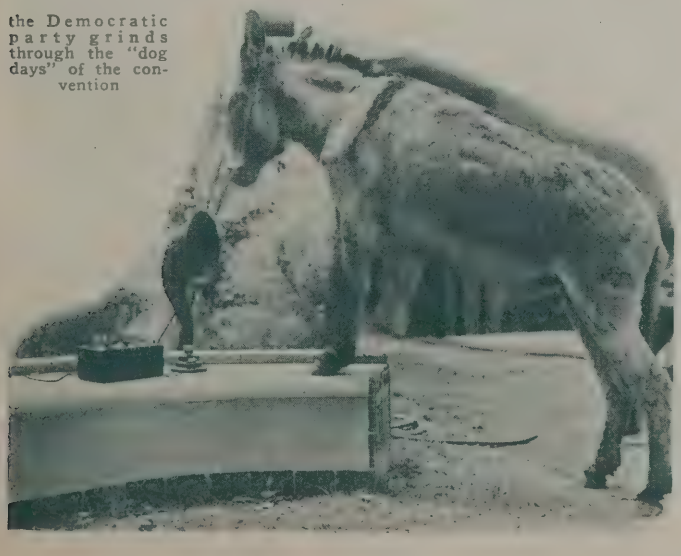
Senator Borah, in one of his speeches, said:

"It is one of the advantages of party government that one political party vigilantly watches and criticizes the other. I hope that will always be so. The conditions would soon be intolerable in this country if it were not so. The danger arises not out of criticism and exposure, but out of a tacit truce between the great parties that they will not criticize or expose the evil practices."

Senator Robert M. La Follette, it is to be hoped, will profit by the lesson beyond price that radio taught us in the June conventions. Broadcasting politics has served to educate us. And we are prepared to tune in for a liberal education from the third party.

THE Republican Convention in Cleveland was broadcast by sixteen stations located at points as far east as Boston and as far west as Kansas City, Missouri. Graham McNamee was the official announcer. His voice was carried below the convention hall to the control apparatus and there distributed over land wires to the stations situated at strategic points for the complete dissemination of all the convention proceedings. KDKA of course, relayed the entire convention to KFKX at Hastings, Nebraska, affording a greater range throughout the west coast states.

One of the most exciting periods of the Republican Convention in Cleveland was during the speech of John Adams Cooper, a delegate from Wisconsin, who offered a minority report to substitute for the majority report of the Resolutions Committee. The radical changes in the platform which he proposed aroused considerable interest on the part of the delegates. After speaking for five or ten minutes, the radio audience heard a great many hisses and boos and shouts which seemed to be in derision of the speaker. But the delegates though unsympathetic, were quite anxious to hear Mr. Cooper who offered the first real thrill of the convention. The hissing was directed at the Sergeant-at-Arms who was stepping forward to the end of the platform as if to lead the speaker away because the time allotted to him had expired. But the Sergeant-at-Arms was actually trying to push Mr. Cooper a little nearer the microphone so that the radio audience could have the full benefit of the political drama he was enacting.



the Democratic party grinds through the "dog days" of the convention

General Dawes and his family listened in on the convention proceedings at a friend's home in Marietta, Ohio. Wholly unprepared for what was to come, the little gathering sat around chatting and speculating on the turn of events. Suddenly, the party was thrilled with the announcement that General Dawes had been nominated for the Vice-Presidency. Crowding around the loud speaker they heard in detail the particulars of the dramatic episode unfolded, and heard before the announcer's voice reached the delegates in the convention hall.

Eric H. Palmer, writing for the *New York World*, expressed his delight with the broadcasting of the convention. His enthusiasm reflects the real spirit of radio fans all over the country. He reported in part:

"Friends were listening in with me on the radio to the Republican National Convention in Cleveland.

"They admittedly were thrilled by the oratory, music, and the just plain noise that issued from the loud speaker. They said they had no difficulty in fancying themselves viewing the proceedings from vantage points right in the auditorium, instead of reclining at ease in a quiet room 600 miles away.

"Surely it makes our hearts beat faster to contemplate the candidates for President and Vice-President listening in, many hundreds of miles away, as their names are being cheered by delegates and spectators.

The opening session of the Republican Convention at Cleveland, Ohio. Microphones stood in front of the speakers and loud speakers hung over the platform projected the voice evenly over the hall

"To Calvin Coolidge have come two most dramatic episodes: first, to be sworn in as President of the United States by his father, in the little farm house in Vermont where he was born, and second, to sit in Washington to hear the eloquent words and the applause that marked his nomination as the choice of the Cleveland Convention. And General Dawes, out in Marietta, Ohio, listening in on a friend's receiver, heard the balloting that again called him into the public service, so that he knew long before the swift telegram, that he had been drafted to run with Coolidge.

"Radio annihilates distance, eliminates the time factor and provides us with the sense of being there when things happen. It gives us a greater zest for reading the papers the next day to get the stories of what has happened behind the scenes and to ascertain the way happenings to which we have listened have been described by journalistic word-painters.

"Thus radio and the press work hand in hand, not rivals, but adjuncts to each other—in the public interest."

THE Democratic Convention at New York was probably more exciting, and came to the attention of more people, through sheer length. Microphones placed on the dais in front of the speakers carried the voice to twenty stations located throughout the country.

The American Telephone and Telegraph Company, and the Radio Corporation of America were foremost in broadcasting the convention proceedings. Boston, New York, Washington, Schenectady, Buffalo, Providence, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Atlanta, Worcester, Kansas City and Hastings, Nebraska, were all represented. In some of those cities, several stations divided the honors. Graham McNamee was the announcer for the telephone company, and J. Andrew White announced for the Radio Corporation of America. Both announcers were stationed in glass booths, sound proof, but advantageous for close observation of the speakers and the delegates.

Microphones, distributed throughout the audience, could be cut in for the cheering and pandemonium that reigned when some critical move on the part of the delegates set the house off in wild demonstrations. Frequently the announcers had to break in with a brief description of the excitement and its cause. They kept in close contact with the control apparatus operators located below the hall by a system of buzzers and telephone connections. The personnel employed to broadcast the convention had to stay at their posts, in some instances, for twelve and thirteen hours.

This writer had occasion to sit through weary hours of balloting, the monotony being broken by nothing more exciting than a sojourn to one of the "hot dog" stands, and so it is with heart-wrung sympathy that an expression of deep understanding and gratitude is hereby extended to the broadcast personnel.

Soon after the convention opened, John Brown's ghost stalked about the Garden, recalled to sordid affairs of earthly origin at the mere mention of Wilsonian principles. The tumultuous clamor of leather-lunged convention fans rose in great waves of intonation that swept across the hall and broke in a mingled roar of stamping and shouting, and whistling and singing. The hilarious abandonment of a mob gone mad was truly infectious. Some one started a parade. Under the flag-draped roof of the Garden, five thousand people milled in the sweltering heat of a packed hall. As a single voice, the yell rose from fifteen thousand raw-hide throats: "Hail! Hail! The gang's all here!" The convention racket reverberated long after the commotion had subsided.

Other demonstrations marked the proceedings from day to day. The states up, standards in parade, the march going around the hall, and the audience on chairs and tables was a less frequent occurrence as the convention straggled out to repeated balloting. Forty ballots—forty odd—fifty—fifty odd—and so on seemingly for an interminable duration. An unexpected break in the unit rule of some state would bring a crash of applause, flags and handkerchiefs waving wildly by way of emphasis. But the proceedings proceeded, and with the sagacity of Poe's "Raven," we were prompted to quoth: "Evermore!"

Or was it, "Nevermore?"

MR. H. P. DAVIS, Vice-President of the Westinghouse Electric and Manufacturing Company, has been actively engaged in the development of radio dating back to the early pioneer days of KDKA. His contribution to this article is a dedication to the basic principles of American politics broadcast—mind you—broadcast to the American people. Here it is:

"From the reaction of the public to the broadcasting of the two greatest political demonstrations in the world, the Republican and Democratic Conventions, it must be ap-

parent to the leaders that political campaigns of the future must be conducted along different lines from those which were successful in the past.

"For the first time in history, the voting public heard every detail of the proceedings of the political conventions. It heard the wild, tumultuous shouting, the noises of the parades of the cheering delegates, the demonstrations that accompanied the nominating, and finally the enthusiastic scenes that accompanied the voting. The music of the bands and the singing of the artists also played a part in making these political conventions the greatest radio demonstration, or for that matter, the biggest thing in history that was ever brought to the ears of the public.

"The noisy demonstrations, the school-boy enthusiasm of the delegates, the three-ring circus aspect of the entire affair was lost upon the radio audience because it could not see the action. Such appeals to the emotions cannot be made by radio and there is no such thing as working up 'mob effects' on the radio listener seated in his own home. Therefore, the political managers, always eager to follow the lead of the public, will probably conduct their future campaigns along somewhat different lines.

"Candidates and campaign managers will come before the microphone and in carefully-worded, well-chosen addresses will state their positions on the various issues of the day. Music there may be with such political campaigns but the day of the stump speech, with the dramatic gesturing of the speaker and his frenzied words, the equally tempestuous parades of his cohorts; this whole appeal to the emotions is passing with the growing use of the radio telephone to broadcast over the entire United States. Radio will play a large part in the election of candidates of the future and because the voting public, at least the greater percentage of them, will actually hear their candidates, it is believed that the voters will grow more and more particular in making their choice.

"Broadcasting the proceedings of the conventions will undoubtedly, this year, bring more people to the polls than have ever before voted. The reason for this is because more people than ever before are taking an interest in the Presidential race since they have heard some of the convention proceedings by radio and have naturally made up their minds, one way or another, regarding the placing of their vote."

Mr. Davis also points out that since KDKA and KFKX have broadened out to international scope, the broadcast proceedings of the conventions were received in Argentina, South America.

Are we proud of our political conventions? Will we be equally proud of our political leaders during the present campaign? The world now listens in.

"Leaders in future political conventions," Mr. Davis believes, "will keep the fact in mind that their demonstrations are being heard not only in the United States, but also across its border and that the Canadians, the Mexicans and the Central and South Americans are also listening in to us choosing our presidential candidates. Perhaps with this in view there will also be other changes in political conventions in the future which will make their proceedings more in keeping with the dignity of the position the United States holds among the world's nations."

NEWSPAPERS were quick to realize the value of radio in reporting the proceedings of the convention. Every newspaper was represented at the conventions. Several foreign newspaper correspondents in reporting the Democratic Convention listened in on a Radiola Super-Heterodyne placed in a room at the Waldorf Astoria in New York. Other journalists and feature writers for American papers likewise engaged a room in the hotel and listened in on a Super-Heterodyne, exploiting to advantage their semi-privacy.

Removed from the heat of the riotous conventions, city editors of newspapers in Western and Mid-western towns copied the proceedings accurately, count by count. Corrections were had even before the reporters seated below the speaker could record them.

The significance is worthy of some reflection. Most city editors have resented the space devoted to radio sections and supplements. They have made the altogether pertinent observation that radio news belongs in the news columns. Radio features, technical articles, and broadcast stories absorb valuable news space. They really belong, it would seem, in magazines. There is certainly no doubt that a daily is purchased for news and a periodical is sought for stories and articles wholly devoted to subjects of deliberate treatment. And so it is that city editors turn to radio for news with the weight of editorial forethought.

Mr. Ford, city editor of the *N. Y. Evening Telegram and Mail,* transferred his Super-Heterodyne from his home to the office, and listened in on the convention proceedings for long hours, unwilling to relinquish his post lest some development escape his personal attention. This, in itself, was notable because Mr. Ford had originally been reluctant to employ any such device for news.

The Democratic Convention at Madison Square Garden, New York. Microphones were placed on a dais in front of the speakers. Loud speakers overhead projected their voices over the massive auditorium

Another striking example of radio news reception was manifested by the *Brooklyn Times'* office. The following is an extract from an editorial in that paper:

"Seated with a set of ear pieces around his head, John A. Heffernan, Associate Editor of the *Brooklyn Times*, pounded the typewriter in perfect rhythm with the air waves that flowed into his ears through the *Times'* office radio.

"It was a remarkable feat, made possible by the combination of the latest achievement of science and a journalistic master hand. As a result, the story reads as vividly as an expert radio announcer's report plus the inimitable charm of the written word. It will long stand unique in the chronicles of 'covering' conventions, and has the additional value of being safe from frequent imitation—because there are very few men even among the best in American journalism who possess the joint abilities of speed, fluent language, quick wit and a mind so receptive that an impression it has once received immediately reflects itself in a polished sentence."

Senator Robert M. La Follette has decided a Third Party is needed

This editorial expresses the exact attitude of many other newspapers scattered throughout the United States and in some foreign countries. As a matter of fact, the reaction of the press was too broad in scope, and includes too many dailies, for record in this article.

IMMEDIATELY after the Civil War, the majority of this country were middle class. Industrial wage earners were little known and capitalists were hardly of consequence. Each man had his little shop in the back yard and was comparatively independent. Colt discovered that he could pay men higher wages to work in his plant than those men could earn for themselves. And likewise, others with a new mechanical device had a market that made possible good pay to those who would become factory workers.

Today, the middle class—those who have an income they have not, themselves, earned—is a passing phase of America's economic and social structure. Workers—those who earn wages—are the great majority. Capitalists—those who control industries—although still a minority, are nevertheless a power. It is to these gentlemen that we turn for guidance. They are successful, and consequently must know the way.

We must pause, however, to reflect that these same gentlemen are equipped to follow a course that might be extremely difficult for us. Observation is good. Imitation is bad.

A stroll through the financial houses of Wall Street will reveal the fact that radio has been used for listening in on the conventions and is being used to receive the campaign news. The reason is simple enough. The big men of this country want to know what is going on in the political camps so that they will know what to do with their votes next November. They heard the conventions broadcast. They separated the ambiguous from the real. They now listen in to check on the results of their observations. It is important to them, and it is equally important to us.

Receivers were installed in Wall Street. Mr. Noyes, President of the Associated Press, had one aboard his yacht. Ex-Governor Glynn of New York, confined in the hospital, listened in on a radio. One was installed in the Children's Court of New York. Another was operated in the Beth Abraham Home for Incurables. James J. Davis, Secretary of Labor, had one in full operation. Others were installed for Judge Gary, John Hays Hammond, Jr., Otto Kahn, Major General O'Ryan, Ex-Governor Henry Steward of Virginia, Dr. Dellinger of the Bureau of Standards, Police Commissioner Enright of New York, and a host of other prominent individuals.

A Radiola Super-Heterodyne was installed in the White House. These sets, requiring no aerial, ground, or other bothersome connections, have found a welcome in homes and offices that heretofore have not been graced with radio. The result has been an unprecedented radio attendance at our National Conventions.

On the streets of New York, evidence of a remarkable interest in the conventions met the casual wayfarer at every turn. The police department attributed the unusual traffic drop to radio. Eight theaters closed during the Democratic Convention and blandly asserted that radio was responsible. A severe falling off of freight traffic on

(*Turn to page* 57)

Rain did not dampen the ardor of fans who listened in on the conventions. The Western Electric Public Address System drew large crowds at all times.

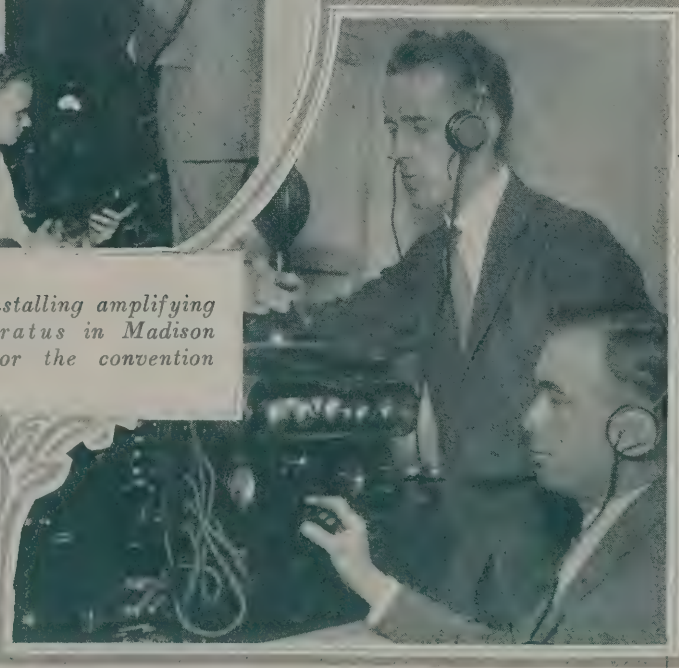
Broadcasting the Conventions

Graham McNamee, official announcer for the American Telephone and Telegraph Company at the Republican and Democratic Conventions. This photo, was transmitted by wire

J. Andrew White, official announcer for the Radio Corporation of America at the Democratic Convention in Madison Square Garden, New York. He is well known for broadcasting sports

Radio engineers installing amplifying and input apparatus in Madison Square Garden for the convention

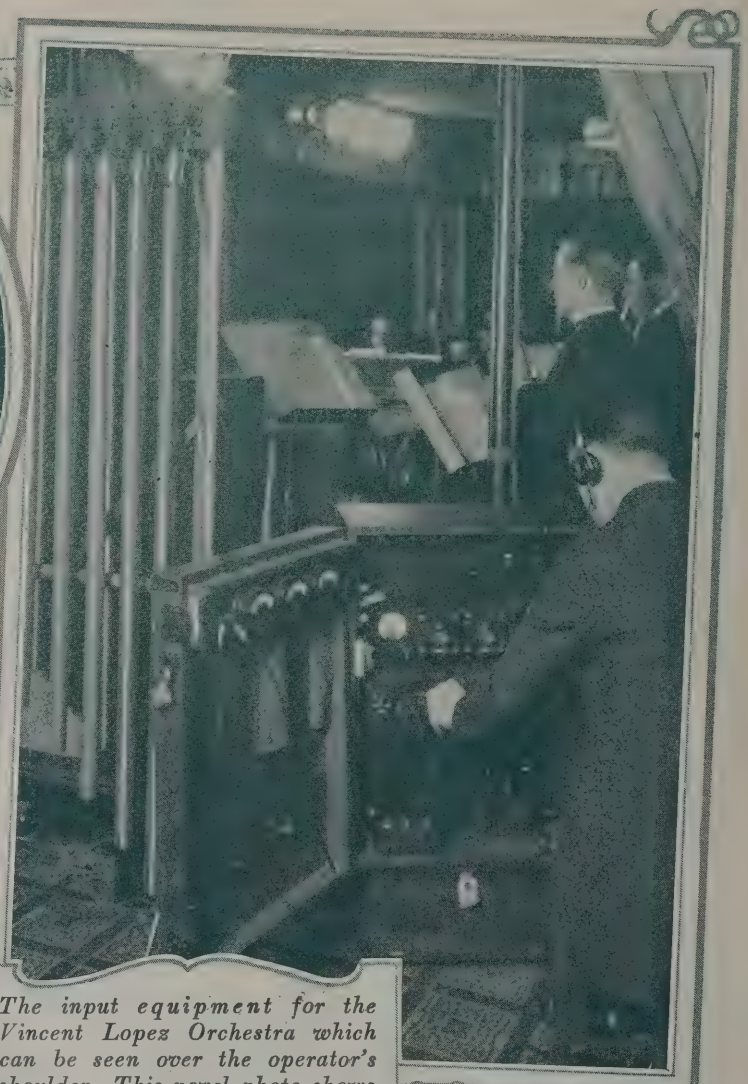
The broadcast station at the Republican Convention. The proceedings were transmitted by direct wires to stations WGY, WGR, KDKA, KSD, WDAF, WJZ, WRC, WJAX, WTAM, WLW, WCAP, WGN, WLS, WMAQ, WNAC, and WEAF. This range included Hastings, Neb., west, Boston, east, and St. Louis and Washington, south



One of the input installations at the Democratic Convention. Proceedings were transmitted by direct wires to stations WJZ, WEAF, WGR, WCAP, WRC, WNAC, WTAT, WJAR, KDKA, WTAM, WJAX, WLW, WGN, WLS, WMAQ, KSD, WDAF, WDBH, WSB, WBZ and WGY. This includes Atlanta, Ga., south, Boston, east, and KFKX (relayed), west

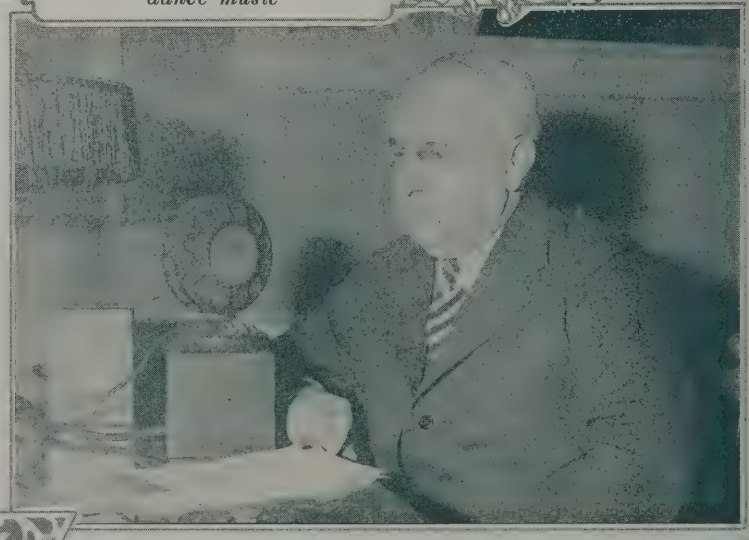
Broadcast Artists You Have Heard

Ralph Mayhew, "Bubble Book Stories," the bedtime story teller who tells 'em from station WJZ



The input equipment for the Vincent Lopez Orchestra which can be seen over the operator's shoulder. This novel photo shows the "business end" of your dance music

Mrs. Harold McCormick, nee Ganna Walska, lyric soprano. Photo made on the occasion of Mme. Walska singing from station WJZ at the Waldorf Astoria. Her radio reception surpassed all expectations



Frederick William Wile, WRC's political observer who broadcasts his reviews, "The Political Situation in Washington Tonight." Mr. Wile is one of our foremost political writers and correspondents

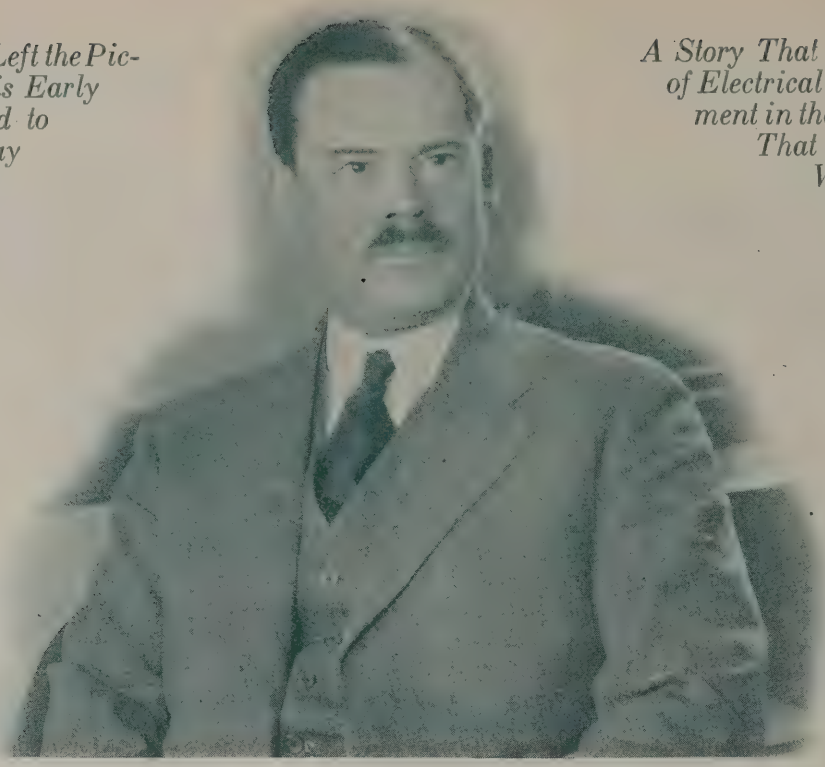
Enjoy Summer Radio

A radio on a summer's day picnic adds to the things we like best. The dancing may not be what it could be, but the real fun is there just the same

Not a mermaid—merely a mere maid listening in. A portable set on the beach is a welcome pastime between dips

In the last month of summer, two winsome maids have carried their radio to the edge of a woodland lake, there to enjoy the rapture of nature in its virgin glory with the best of music and culture brought to them in the peace and rest of the open air. The reflected trees of the distant shore enhance the cool, translucent memories of a lake in the wild

E.F.W. Alexanderson Left the Picturesque Regions of His Early Boyhood and Migrated to America Where His Day Dreams Would Come True



A Story That Demands a Review of Electrical and Radio Development in the Telling—a Review That Could Not Be Told Without the Story of This Personality

A Radio System Built Of Air-Castle Dreams

By Harvey Clawson

A PICTURESQUE river, winding through a fertile and historic plain of Sweden past Tingshög hill where the ancient pagan kings led the people to worship, flows into the university city of Upsala, dividing the new from the old. Ascending the hills on the west shore, the old town leads up to the fine French-Gothic cathedral that dates back to 1260.

Among the university buildings in the vicinity of the cathedral are the ancient Gustavianum, built in the reign of Gustavus Adolphus, the Carolina Rediviva, and the handsome new Renaissance structure completed in the early eighties. Nestling in the heart of this charm, redolent with the memories of antiquity, the botanical garden offers a haven of peace for the students who stroll down the walks seeking, perhaps, a refuge from the perplexities of youth.

Professor A. M. Alexanderson, standing at a window of the university library, watched the students as they hurried away in the various directions to which their several interests led them, and he reflected, as he idly studied their mischievous demeanors, that his young son would some day don the student cap which designates the wearers' class year, and consequent social status. Long after the last care-free voice had resounded over the garden, and the echoes of irresponsible youth were lost in the shadows of a Mediaeval glory, Professor Alexanderson stood at the window and pondered on the future of his boy, and he wondered as he stood there absorbed, what the future held forth. A faint smile crept over his face as he thought of the many fathers who had meditated at length over the same problem only to find in the end that an individuality is apt to be too intangible for arbitrary standards; always beyond the grasp of well-meaning intentions.

"This boy of mine," the professor reflected, "shall have the opportunities —all of them—that education will afford." He turned to depart, satisfied that for the present, at least, his procedure was obvious.

That night, as he lay thinking of the day's problems, an impish thought stole into his mind. He knew the dangers of over-education. "What," he asked himself, pointedly, "would happen to my well arranged schedule if the boy lacked the practical turn of mind so essential to the useful application of acquired knowledge?" Whatever the answer, it was lost in sleep.

* * *

E. F. W. Alexanderson, the professor's son, graduated from the High School of Lund of 1896. The next year, in the shadow of the old Romanesque Cathedral, the younger Alexanderson studied at the University of Lund. With an early life steeped in the historic atmosphere of the ancient and picturesque regions of old Sweden, he entered the Royal Institute of Technology at Stockholm, eager for the learning that lay beyond the threshold of his boyhood world.

A post-graduate course at the Koenigliche Technishe Hochschule in Berlin, and contact with cosmopolitan Europe, merely served to accentuate his curiosity. His was an open mind, ever receptive to greater knowledge, stimulated by a restless spirit that recognized no bounds. What he had learned seemed to be of small consequence, devoid of any immediate value. His mind soared into the realm of day-dreams and air-castles. The substance of his visions always seemed just be-

yond the grasp of intrigued fancy. He must seek for greater opportunities. He must go where advancement was not stifled by the inhibitions of precedent. It was then that he turned to America. * * *

E. F. W. Alexanderson migrated to the United States. That was in 1901. He entered the services of the C. & O. Electric Company as an electrical draftsman. One year later, he joined the staff of the General Electric Company at Schenectady where his extraordinary ability and inventive genius were soon recognized. His day dreams and fancies were caught and poured into the mould of practicable mechanics. Theories were cast into facts. His promotion to the position of consulting engineer was inevitable.

Today, Alexanderson stands at the pinnacle of success as the Chief Consulting Engineer of the Radio Corporation of America.

Mr. Alexanderson has been awarded a Medal of Honor by the Institute of Radio Engineers, in recognition of his contributions to the science of radio communication. Nevertheless, he is one of the most modest of men. It is only with great difficulty that he can be induced to take a prominent part on any official occasion.

Indifference toward his acquired knowledge is characteristic of him. His restless spirit still drives him on to solve the seemingly impossible.

While engaged in solving the problems encountered in the application of electrical power to the railways and industries, it occurred to him that the general principles adopted in power engineering might in many cases be applied to radio telegraphy. It was about this time that the need of a powerful high frequency dynamo for long distance wireless telegraph communication became apparent. For a long time radio engineers had recognized the inefficiencies and limitations of the so-called "spark" and "arc" systems of generating high frequency currents, yet none of them were prepared to undertake the design of an alternator which would produce these currents directly. The problem in this case was the production of generators giving frequencies up to 100,000 cycles per second instead of the old requirements of the low-frequency dynamo used in ordinary power work, giving 60 cycles of current per second. This was a stupendous problem, and it was deemed wholly beyond the range of possibility.

Mr. Alexanderson pulled off his coat, rolled up his sleeves, and set to work with a smile of confidence. In the space of several months he had designed a practicable 100,000-cycle alternator giving an output of 2 kilowatts. His smile broadened to a grin.

"The radio engineer," Mr. Alexanderson said, "is, more than any other, compelled to work with conditions which are not within his control, and only partially understood. The law of probability and averages must therefore figure largely in his calculations."

It is notable, however, that he does not allow the law of probability and averages to enter into his results.

This first alternator, designed by Mr. Alexanderson, ran at a speed of 20,000 revolutions per minute, yet through the extraordinary care taken in its construction it functioned uninterruptedly. The output could be fed directly to the antenna system for the generation of the electromagnetic or ether waves of radio telegraphy.

The need of a more powerful high frequency dynamo was soon evident. Alexanderson and his assistants then undertook the development of a 50-kilowatt, 50,000-cycle alternator which proved successful at the New Brunswick high power station of the Radio Corporation of America. But a still more powerful generator was needed for continuous trans-oceanic wireless communication under all conditions.

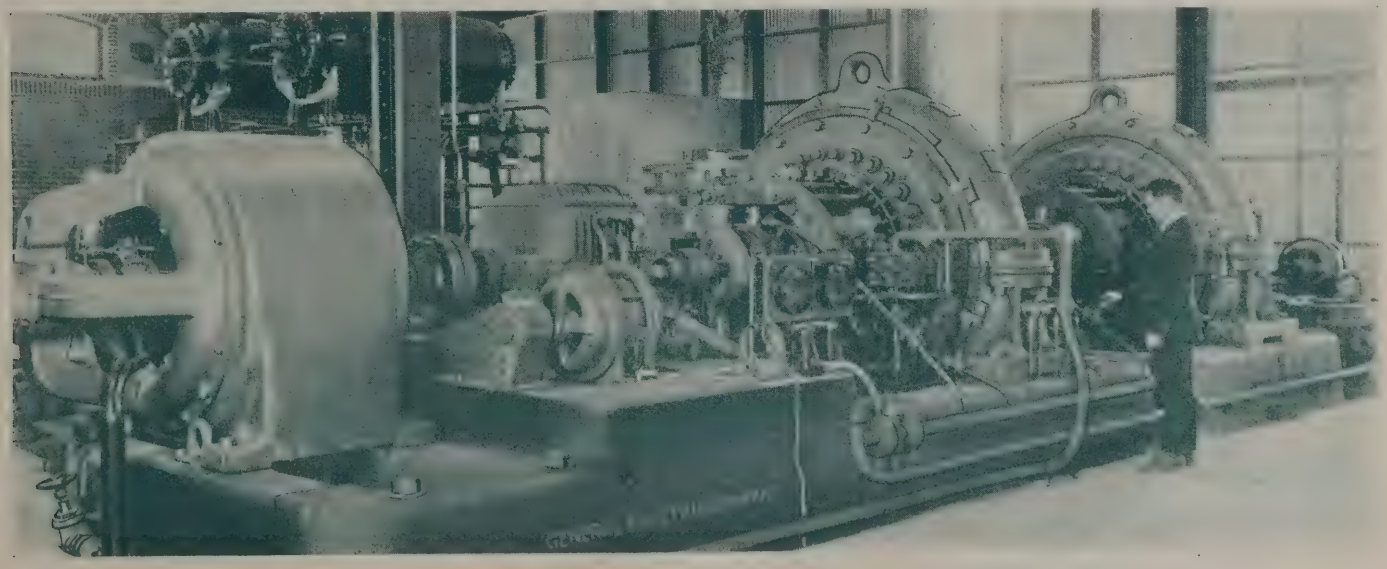
Mr. Alexanderson then accomplished his crowning achievement. He developed an alternator of 200 kilowatts, 27,000 cycles. Two of these gigantic machines were installed at the Radio Corporation of America's trans-oceanic station at New Brunswick, New Jersey. * * *

This high power radio station, the Alexanderson type, contains three important developments:

1. An alternator which generates currents directly at the frequencies which are required for radio circuits with which it is associated.
2. A magnetic amplifier which provides a non-arcing control of the alternator output for radio telegraphy, and is equally applicable to radio telephony.
3. A multiple tuned antenna which has markedly reduced the wasteful resistance of the flat-top antenna, and has therefore increased the transmitter over-all efficiency many fold.

These developments have been accomplished by Mr. Alexanderson, and perhaps can only be appreciated by those who are familiar with the problems of radio telegraphy.

The Alexanderson alternator is an inductor type of generator with a solid steel rotor having several hundred slots milled radially on each side of the rim. The slots are filled in with non-magnetic material, with the object of reducing wind friction to a minimum. The fillers are brazed into the disc in order that they may withstand the centrifugal strain of rotation. The rotor is designed for maximum mechanical



The Alexanderson alternator which generates currents at the frequencies that are required for radio circuits

strength by providing it with a thin rim and a much thicker hub. With this construction the strain on the material due to centrifugal force is the same from the shaft to the outer rim.

In regard to some of the electrical features of the alternator it will be noted that the armature and field coils are stationary, the requisite flux variations for the generation of radio frequency currents being obtained from the slots cut in the rotor. The rotor disc revolves between the two faces of the field yokes. The direct current supplied to the field coils produces a magnetic field flux which passes between the field yoke faces and through the rotor.

A solution of the problem of speed regulation with A. C. motor drive was found by Mr. Alexanderson in the use of a resonance circuit, which is tuned to a frequency slightly above the frequency to be maintained at the alternator. This circuit is supplied with current from one of the armature coils on the alternator. The current in this circuit increases with alternator speed, and, through the agency of a rectifier, a D. C. component operates on a voltage regulator connected in the circuit of the dynamo which supplies the saturation current for a set of variable impedances in the two phases of the motor supply circuit. The function of the regulator is to prevent, within established limits, either an increase or decrease of alternator speed.

The multiple tuned antenna used here may be said to establish a radical departure from the types of antennas formerly used for high-power radio transmission. The immediate object of the multiple antenna is to reduce the wasteful resistance of the long, low, flat-top aerials formerly used and to permit the length of such aerials to be increased indefinitely for the use of greater powers. The radiation qualities of the flat-top are not impaired by multiple tuning, as a series of tests have shown that with an equal number of amperes in either type, the same signal audibility is obtained at a receiving station, but there is an enormous saving of power in the case of the multiple antenna.

The multiple tuned antenna has, instead of the single ground wire usually employed, a number of ground leads which are brought down from the flat top at equally spaced intervals, and connected to earth through appropriate tuning coils.

The earth-wire system at the New Brunswick station is a combination of a buried metallic and a capacitive ground. Sixteen parallel copper conductors are laid underneath the antenna and buried one foot in the ground. They extend the entire length of the antenna and are spaced between towers. A network of wires and zinc plates are also buried in the ground around the station. At each of the five tuning points outside the station, connection is made from the antenna flat top to the sixteen underground wires.

A still better distribution of the earth currents at New Brunswick was obtained by using a capacitive ground commonly known as a counterpoise, which is erected underneath the antenna and a few feet above the earth.

Telegraphic control of the large antenna currents involved in high-power radio transmitters has ever presented a difficult problem. Particularly has this been true when signaling at high speeds. Rapid signaling obviously requires some device that will not cause destructive arcs and will provide the desired modulation of antenna power without taking upon itself the burden of carrying the full power of the system, during the intervals between signaling.

The magnetic amplifier is a device which meets these exacting requirements, for it provides a non-arcing control with a minimum current in the key circuit, and it takes within itself only a small proportion of the total alternator output.

The magnetic amplifier in general may be described as a variable impedance which is connected in shunt with the external circuit of the radio frequency alternator. Its function is to reduce the voltage of the alternator and to detune the antenna system when the sending key proper is open, and to perform the opposite functions when it is closed. Thus when the sending key is open, the amplifier short-circuits the alternator and detunes the antenna system, thereby reducing the antenna current to a negligible figure. When it is closed, the output of the alternator is fed to the antenna system.

A standard tower for high-power stations is used. This is of the self-supporting type erected on a suitable concrete base. The antenna wires are suspended from the steel cross arm at the top. This method of antenna suspension lends itself admirably to the long narrow antenna which has been found most suitable for the Alexanderson System. * * *

In explaining all this, Mr. Alexanderson injects a touch of the romantic. "It is the aim of the radio engineer," he says, "to chart the sea of ether, to weather its storms and to provide a continuous service of communication day and night."

And he continues: "The transoceanic radio station is a power station. Its input is kilowatts and its output is words. The problem of radio engineering is to establish the relation between kilowatts input and words output. This relation between kilowatts and words is a chain comprising four separate subjects which are being studied by specialists in those subjects. They are:

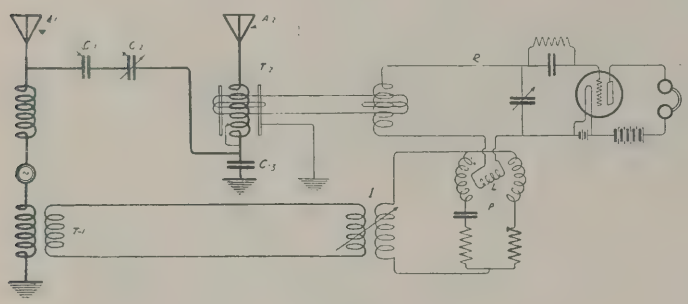
"1. Relation between kilowatts consumed and wave energy radiated.

"2. Relation between wave energy at the transmitting station and wave energy at the receiving station.

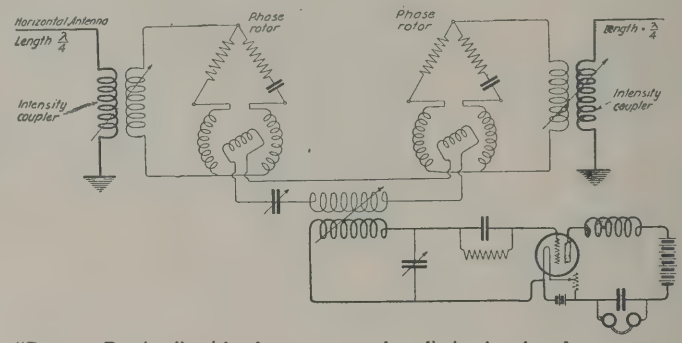
"3. Relation between wave energy at the receiving station and the speed at which words can be received.

"4. Influence of atmospheric disturbances.

"The first subject deals with the radio power station and the antenna. The Radio Central antenna at Rocky Point, L. I. is designed from the ground up. It has six ground connections distributed over a distance of one mile and 150 miles of wire buried in the ground. Through these devices the ground resistance has been reduced to 1/10 ohm. The best types of antenna previously used have ground resistances of about 2 ohms. The



Fundamental circuit of the "Bridge Receiver"



The "Barrage Receiver" with phase rotators for eliminating interference

losses in the ground have thus been reduced at the rate of 20 to 1.

"The second subject is wave propagation. We have now a great deal of practical data which can be summed up in the rule that the most economical wave length for communication over a certain distance is about one five-hundredth of the distance.

"The third subject deals with the design of the receiving station. It has been found that the speed in words per minute at which it is possible to receive telegraphic code is directly proportional to the amplitude of the wave. A signal field strength of 50 microvolts per meter corresponds under average conditions to a speed of 50 words per minute.

"The fourth subject deals with the atmospheric disturbances. Our modern receiving system eliminates about 9/10 of the disturbances, but the residual which is not eliminated determines the speed of reception by the law of inverse proportionality.

"For elimination of disturbances we use a new type of antenna about ten miles long. It is a simple telegraph wire mounted on ordinary poles. It is not tuned for any particular frequency, and waves at all lengths travel along the wire with the velocity of light. The ether wave thus starts a wave on one end of the wire, and this wave travels along the wire while the original ether wave follows beside it in space, constantly adding energy to the wave on the wire, just as the wind starts a ripple at one shore of a lake and rolls it up to a large wave as it travels along. Thus the wave intensity in the wire grows and becomes a maximum at the far end of the wire. Fortunately on the Atlantic coast, most of the disturbances come from the West, whereas the signals come from the East. The wave antenna thus separates the signal from the disturbance so that the signal appears at the east end of the wire and the disturbance at the west end. The energy of the disturbance is destroyed by absorption in a resistance at the west end of the wire, whereas a practically pure signal can be collected at the east end.

"With the data that is thus available the planning of a new radio system is no longer a matter of guesswork. Before designing our South American system, we sent an expedition of engineers to chart the atmospheric disturbances. Their findings led to a modification of the original plan because it was discovered that at the location first selected, the principal disturbance came from the same direction as the signal, and therefore could not be eliminated. From the data now available it is possible to calculate the number of words that can be received during each month in the year, although the stations have not yet been built."

* * *

Building the radio telegraph station at Warsaw, Poland, was a gigantic engineering project. Of course, the Alexanderson system was installed. Mr. Alexanderson was a leading figure in the furtherance and final realization of this station which is now in daily communication with the Radio Corporation of America, Broad Street Office, operating both ways at a speed of 80 words per minute.

It was early in 1919 that the then newly constituted Polish Government realized that direct communication with the world, and especially with the United States, was essential. Surrounded as she was by nations whose hostility was either open or hardly concealed, she knew that reliance could not be placed upon the existing wire methods of communication, which entailed the use of the facilities of other nations. Radio was the one most flexible, efficient and certain solution, and the determination to erect a radio station of high power was taken early in the history of the new nation. However, due to the necessity for placing finances in order, and investigating the offers of the various radio constructors, it was not until August 4, 1921, that the Polish Government signed the contract for the station it so eagerly desired. By this contract the Radio Corporation of America agreed with Poland to construct for it an international high power radio station of the most modern type, at an approximate cost of $2,000,000, and to have it working in 1923. The promise was kept, and the actual operation of the plant has gone forward with the ultimate success.

The station in Poland is equipped with a broadcast receiver that has been fitted with loading coils so that it is capable of tuning to the long wave lengths of the Radio Central transmitter, and messages for Poland are sent direct on a regular schedule.

The Poland station is interesting in a number of ways, besides its general resemblance to the famous Radio Central at Rocky Point, Long Island. Probably the most striking feature of the installation is the power plant, in which some unusually difficult engineering problems had to be solved.

(*Turn to page* 80)

The multiple tuned antenna system which has markedly increased the over-all efficiency of transmitting stations

The Beverage receiving antenna at the Radio Corporation of America receiving station at Riverhead

Senators Howell Broadcasting the

Ralph B. Howell

U. S Senator from Nebraska

Introduced a Resolution in the Senate to Broadcast Its Proceedings

BELIEVING that fundamentally and basically the safety of the government rests on the widest and fullest publicity of what the government is doing and contemplates doing, I introduced a resolution in the Senate requesting the Secretaries of War and the Navy to co-operate in the appointment of a joint commission of radio experts from their respective departments to investigate and report to the Senate upon the equipment of the Senate chamber with electrical transmission apparatus so that the proceedings may be adequately heard by every one in the chamber and so that the proceedings may be broadcast.

Some of the details I had in mind were the placing of loud speakers in each Senate cloakroom and in each Senator's office so that if a Senator were compelled to be absent from the chamber itself he might be able to know exactly what matter was being considered by the Senate and to what stage it had progressed. This idea could of course be extended to the office of the President and other high government officials.

There is often confusion of voices in the Senate chamber due to the low tone of voice used by some Senators and also to the proclivity of people to get together in a corner and discuss something. I had in mind a receiving and sending apparatus at each Senator's desk. When a Senator starts to speak this could be turned on; all other transmitting apparatus in the chamber would then be turned off. Any Senator who was not hearing clearly could turn on his receiving apparatus, and turn it off when he chose. In this way every word spoken which should be heard would be heard and of course be broadcasted.

My idea was to use the existing Army and Navy Stations. Immediately upon the announcement of my resolution the Radio Corporation of America volunteered to undertake this broadcasting. The Senate has adopted the resolution. The War and Navy departments are now looking into the matter as set forth in the resolution.

The Congressional Record has a very limited circulation. Those few people who receive it do not read it to any extent. Its appearance is, as literature, uninviting. Consequently very little of the proceedings of Congress reach the people in their original form.

I believe that many meritorious measures would be acted upon and other proposals, which do not deserve approval, or consideration, would not be passed if the people knew the exact time at which they were being considered that these measures were up. Broadcasting of the Senate's proceedings would bring the people into closer touch with what their representatives are doing and would thus stimulate interest in the issues before the country. The galleries of the Senate would be extended to the borders of the country. Many people do not read much, but these same folks are interested in radio and would listen in.

Undoubtedly much of the irrelevant and extraneous talk and debate would be escaped if my plan were put into effect. Some Senators may be apprehensive that "talking to the country" would preclude the transaction of any business in the Senate, if the proceedings were broadcast. But I am not one sharing this fear. The reaction from constituents resulting from the waste of time by unnecessary debate would more than offset the desire to make speeches for political effect. I am inclined to think that the length of speeches and the quality of debate would be respectively shortened and improved.

There would also be a tendency to be present on the part of Senators during the time the Senate is in session. Calls for a quorum would lessen in number. Senators would want to let their constituents know that they are following closely what is going on in the Senate.

The advertising value of broadcasting the proceedings would be great to the individual Senators and to the parties. Some one has expressed a fear that party organizations would exercise rather strict control over the time, with the result that only the best speakers would get much opportunity to set forth their views on the subjects under consideration. There is no such danger. Party discipline is not what it was in the period following the Civil War. No great issues now separate the two major parties. Members of Congress speak and vote with very free minds. I believe every member would be able to say what he wanted to say. This apprehension is not to be seriously entertained.

The procedure and manner of doing things here is a mystery to most of our citizens. The reason is that they do not have facilities to get the information they need to understand how we do things in Congress. When one can put on a head-piece or turn on a loud speaker and hear what is going on in Washington, so far as Congress is concerned, he would in a short time understand just why it takes so long to do things sometimes.

Personal touch is a very moving influence in human affairs. Reading about what happened in Congress is not nearly so stimulating as hearing it as it is being done. The reaction from Congressional action would be many

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and Dial on Senate Proceedings

Nathaniel B. Dial

U. S. Senator from South Carolina

Contends That It Is Not Practicable Nor Desirable

THE Secretaries of War and Navy, by a resolution of the Senate recently adopted, have been requested to form a board of radio experts from their branches of the federal government to investigate the possibility and practicability of equipping the Senate chamber, without defacing it, so that the proceedings could be broadcast. The use of the existing plants and facilities of the War and the Navy Departments is contemplated in the resolution for this broadcasting. The inquiry is to cover also the cost of procuring and installing the necessary equipments, and a report is to be made by the heads of the two departments to the Senate.

Senator Howell, of Nebraska, is the author of this proposal. His resolution includes the consideration also of the matter of so equipping the Senate chamber so that every word spoken in debate, in whatever tone of voice, could be heard easily in any part of the chamber. There is often sufficient noise and confusion, under strained circumstances, to warrant the inquiry as to whether this disadvantage cannot be obviated. I believe something along this line is possible of accomplishment.

I am rather convinced that broadcasting of the proceedings of the Senate is not practicable. The conditions under which speaking is done in the Senate chamber are not comparable to the conditions in a broadcasting station, or to an occasion such as when the President makes a set speech. Any Senator is subjected in the course of a speech or a debate to many unlooked for interruptions. No one can anticipate just when the speaker is about to be asked a question. Debate is so fast and so attentively followed when an interesting and important matter is under consideration that perhaps three or four Senators are addressing the presiding officer at the same instant in an endeavor to get recognition in order to ask the speaker a question.

Granting that some sort of a system could be worked out so that each Senator's desk would be equipped with an arrangement, which could be controlled at a central point, in order that only the Senator actually addressing the chair would have his voice received and broadcast, the operator of this intricate mechanism would have to be inhumanly active and alert to be able even approximately to follow the proceedings. It would, it seems to me, be beyond human ability and dexterity.

So much for the practicability of the project. The experts are the only persons who can tell us whether it can or can not be done. Science can do wonders. It likely will at some time be able to perfect even such an arrangement.

As to the merits of the proposal, I am quite satisfied in my own mind. I believe broadcasting of the proceedings of the Senate would be a bad thing for the country.

Congress would be slow to adjourn. The political possibilities would be enormous. We have too much talking in Congress now. The eyes of the country are ever on Washington, on the Federal Government, especially on the Congress, waiting and hoping, and in many cases, alas, expecting, that something will be done legislatively that will cure this or that public ill. Most of these things cannot be effected by simply passing a law or two. They require the working out of natural laws and economic processes. The basis of our liberties rests on the government, and the interest therein, of our states and small communities. Our people can accomplish much if they will demand that more be done near where they reside, and less at Washington. Not that there is anything which those who do not favor this new proposal would conceal from the public mind. The people are entitled to know all about what goes on in Washington. But we do not want to fix their attention on one agency of the government for the best part of the waking half of the twenty-four hours.

What with the news bureaus, news agencies, news service, special correspondents, and the *Congressional Record* itself, there is surely no dearth of sources to which a curious individual can repair for his information. These various news gathering businesses, each operating independently, covering the same field, are in a very intensely competitive occupation. Each one of them cannot afford to miss anything important. Every worth while fact is related to the public, almost as soon as it happens. The people get this news from several sources, and from each source in a slightly different manner, with the result that all the angles are simultaneously presented to the public's attention for its consideration. The suppression of any news or facts which belong inherently to our people is impossible, much less the passing over of anything done in the legislative bodies, because all the latter are necessarily reported in the *Congressional Record*.

The dignity of the Senate as a body would be sure to deteriorate if the suggestion to broadcast its proceedings in full were adopted. A mighty political

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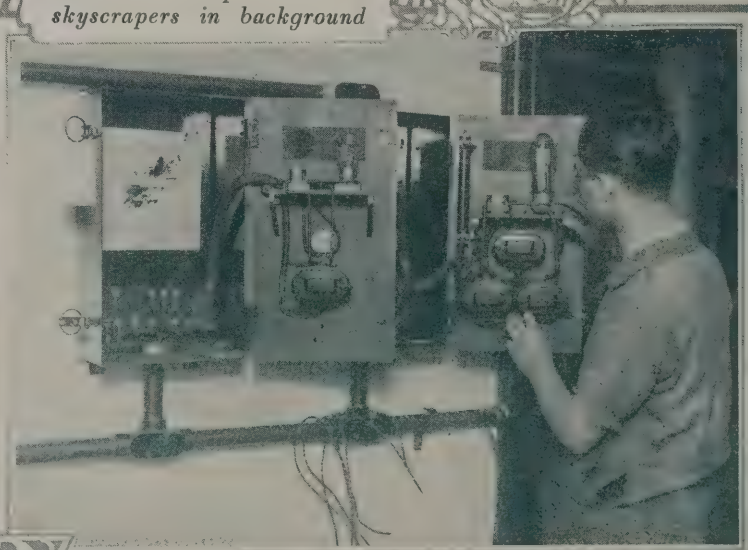
Municipal Station WNYC

Operator at receiving equipment at WNYC. This is primarily for listening in on possible SOS calls

Antenna system in course of completion for WNYC's new broadcast station. This aerial is of the cage type believed to be best suited at this point. Note skyscrapers in background

P. H. Geer at work on the one kilowatt transmitting equipment of WNYC. Many novel features will be broadcast from this new station, one of the most up-to-date of its kind in the country. All broadcasting will be done from the Municipal Building at New York City



Anton Grainer installing the speech amplifiers which step-up the voice vibrations caught by the microphone in WNYC's studio. New York City plans to compete with the best broadcast stations in the country, offering a highly diversified program

To Those Who Attend Church

Radio Church Services Have, From the Very First, Made a Broad Appeal

By Rev. H. F. Fulton

Invalids and Shut-ins as Well as the Isolated Now Attend Services

UNDOUBTEDLY one of the permanent functions of radio broadcasting has become clearly defined when church services are considered. From the first days of this new medium of communication people listened in quite generally to religious services. It is now an established institution.

By means of radio the voices of the clergymen of Schenectady, previously limited to the churches in which they spoke, are now carried great distances. Every Sunday the services of a Schenectady church are attended by two congregations, one visible to the pastor, the other invisible but hardly less appreciative.

For months WGY, co-operating with the Schenectady Ministerial Association, has been putting religious services on the air. Because of the power of the station, the excellence of its modulation and its exceptionally favorable location for distance transmission, the messages of the Schenectady clergy have been carried thousands of miles reaching, especially, thinly populated sections in northern New York, New Hampshire, Vermont and eastern Canada. Each preacher has become known internationally, and his flock has increased many times.

Days after a radio service the clergymen of the church receives letters of appreciation from his listeners. The letters come from invalids, the aged, from the lame and blind and from institutional patients. A great many letters are received from people living in isolated communities where no church services are conducted. Woodsmen,

Rev. H. F. Fulton, Pastor of the Community Church

farmers, forest rangers, keepers of light ships on the coast and fishermen shut in by ice on islands off the Canadian coast have acknowledged reception of Schenectady services.

Frequently the letters contain sums of money, the senders feeling that by contributing to the collection they are more completely participating in the service. Some of the churches have set aside the "radio" collections as a mission fund. Each of the Schenectady ministers has broadcast so often that the listeners feel an intimate personal relationship and the letters breathe warmth and friendliness. Not infrequently the writer extends an invitation for a visit, for a fishing or a hunting trip.

Recently Dr. Philip Frick, pastor of the First Methodist Church, received a letter from a Vermont resident who asked the clergyman's assistance in locating a sister he hadn't seen for twenty years. The correspondent had a vague notion that his sister lived in or near Schenectady. Dr. Frick started an investigation with the result that sister and brother were reunited.

Rev. H. F. Fulton, pastor of The Community Church, at Hampden, Mass., relates the experience of his congregation after attending a radio church service. He says:

An innovation was introduced recently in The Community Church, located at Hampden, Mass., when on a Sunday morning, a radio receiving set was used in connection with the service. On account of my absence while attending a church conference in Lynn, Mass., a service was broadcast from the South Congregational Church, in Springfield, Mass., through station WBZ. The local congregation followed the service throughout, taking their customary seats during the playing of the organ prelude and bowing reverently when Rev. James Gordon Gilkey, of the South Congregational

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The entire morning services at St. Thomas' Church, one of the oldest and best-known churches in Manhattan, is broadcast by station WJZ by means of the permanent microphone installation which has now been in use for over a year and which enables the radio congregation to hear the sermon, the choir numbers, and the hymns by the congregation in the church in practically perfect form. Tiny microphones installed in various parts of the church are switched in and out by the operator as the service changes from pulpit to congregation and from congregation to choir.—H. F. Fulton.

Grandfather and grandmother Keating listening in during Sunday morning church services

Rev. Lyman R. Hartley of the Fort George Presbyterian Church, New York, installs radio sets to relieve sick members of his church

MRS. FREDERICK was at one time consulting Household Editor for the "Ladies' Home Journal," a contributor to "Farm and Home," a contributor to "Modern Priscilla," and is at present Household Editor for "Designer." Her activities in extending the benefits of home life by radio has attracted widespread interest throughout the country. This is a story of a mother who wanted just one career —the career of family and home and radio. Observing the illustration to the left Mrs. Fredericks can say like Cornelia: "These are my jewels," as well as a career.

How I Made a Career Out of Home and Radio

By Mrs. Christine Frederick

Founder of the Applecroft Home Experiment Station at Greenlawn, Long Island, author of "Household Engineering," "The New Housekeeping," and other works to do with scientific home management.

WITH two babies and a home to look after, and a feeling that my college education was going to waste in home drudgery, I was not in a contented state of mind ten years ago. (How familiar this will sound to hundreds of women!)

Then one day my husband and I went to hear Harrington Emerson, the scientific management expert. The tale of how factory work was being revolutionized by modern science fascinated me. Mr. Emerson explained the twelve principles of efficiency upon which all this was based. My college training arose from its slumbers—I got an idea! Why not apply to household work the principles of scientific management? Was not the home the greatest factory in the nation—and the one most behind the times? Were not women everywhere ground down by housework done in the same way, almost as a century before?

My husband and I studied the subject intensively; we laid out a series of scientific experiments; we applied the principles of routed, planned work, of proper equipment at the right levels, etc. It was positively thrilling to see that the principles when applied did yield results, did cut down the housewife's footsteps, did reduce the time necessary to do the work, did eliminate false motions and duplicated effort. You should have seen our house during those experimental periods—kitchen torn apart to raise sinks to the no-stoop level; stoves re-arranged so that the "preparing process" of cooking moved in consecutive line from ice box to dining room door; and the "cleansing process" in a similar line from table, to sink, to drain board to shelves. Stop watches to time motions, pedometers to count the number of steps taken—it was an eye-opening work, in the revelation it gave of the reason why "women's work is never done."

I prepared a series of articles for a great woman's magazine, and they stirred the country. They were printed in book form ("The New Housekeeping," Doubleday, Page & Co.) and I was called upon to lecture before women's clubs and scientific societies all over the country. My book was translated into Scandinavian, German and French. I opened up the Applecroft Home Experiment Station at Greenlawn, Long Island, our summer home, to continue the work, and issued bulletins, and continued my career as a writer for women's magazines and newspapers from the modern housewife's point of view. Previous to that very little but the old, out-of-date material for women had been provided.

I got thousands of letters from women, some of them tearful with the dreariness of household drudgery and pathetic in their eagerness to take a new view and apply new methods to housework. I was hailed almost as a prophetess and a deliverer, a founder of a new practical religion for women. You see, I preached the adoption in the home of the scientific idea with which men have done so much, while women have lingered in an archaic period.

I spent four years preparing a new and complete book—and added two babies to my family during the interval—which would give women a complete text book of the new methods. It is called "Household Engineering";

and is now used as a text book in many schools. Harrington Emerson and Frank B. Gilbreth, both famous engineers, were good enough to write introductions to these books.

I began to be called upon to write articles, prepare booklets and make new experiments and invent new household devices and helps. I was soon in a perfect whirl of work, and needless to say, I was happier the busier I got! But what has from the very start astounded me is that I have not done anything which any other intelligent woman could not have done. I merely stopped despising housework and studied it coldly and scientifically. I merely began to make a career of which most women regard as drudgery. I merely picked up the reins which most women wish desperately to throw down.

Never have I been more sure than now that the solving of the great problem of home-making and housework is a job which women must tackle and solve, and out of which careers are carved. I have the hardest time in the world trying to find an intelligent, trained house-manager for my own home, at very good pay. Think of it! The profession which belongs by tradition and by necessity to most women, and there are almost none available! We are coming rapidly—due to a decreased number of servants—to the point when women must do more of their own housework, but with the best available apparatus; and also we are arriving at a time when we must have professional house-managers available like trained nurses, for women who work in business or professions.

Almost as soon as radio came, I realized what a particularly great factor it was to be in woman's life, because isolation has been woman's greatest bug-bear. Two or three years ago, when radio was an infant, I began making experiments. I have one of the earliest sets made for house use. I tried it in all conceivable home ways—as something to keep the sick-room cheerful; as an attraction to keep children at home nights; as an educative force and as plain home entertainment.

I believed in radio for women so much that I began to broadcast material to women; giving in a cheerful, womanly way the timely information women need for the household. Other broadcasting stations began to read my talks to listeners—even though I was personally absent.

Mrs. Christine Frederick has been actively engaged in organizing a radio cooking class. This class listens in on KYW, Chicago, while Mrs. Anna J. Peterson, director, broadcasts the lessons in culinary skill.

Under the auspices of the Home Service Department of The Peoples Gas, Light & Coke Co., Mrs. Peterson covers every subject of general interest in cooking in a series of twelve lessons. To those who register for this course and send in written reports on at least nine lessons, radio certificates are issued. It is a course well worth the while of every woman who has a radio available. Write to KYW for particulars. The next radio cooking class will commence in October.

Then I was asked by the editor of a famous women's magazine—"Good Housekeeping"—to assert my leadership as a spokesman for American women by writing an article which would tell what kind of material women would like to have broadcast to the home. I prepared a suggested list of things women want. Here it is:

1—*Physical Education*
- a. Daily "setting up" exercises.
- b. "First Aid" instruction.
- c. Health talks.
- d. Beauty hints.

2—*Junior Features*
- a. Little "Children's Hour."
- b. Woodcraft and animal stories.
- c. Adventure and history tales.
- d. Activities of Boy Scouts and Campfire Girls.

3—*Household Interest*
- a. Housekeeping and cooking.
- b. Market reports.
- c. Care and hygiene of children.
- d. Home decoration and furnishing.

4—*Cultural Topics*
- a. Correct English.
- b. Musical programs.
- c. Drama and book reviews.
- d. Fashion and dress discussions.

5—*Social Interests*
- a. Current events.
- b. Public affairs and politics.
- c. News of sports.
- d. Worship services.
- e. Home finance and thrift.
- f. Club and organization activities.

Many of these recommendations were immediately adopted by various broadcasting stations.

Perhaps the most decidedly advanced and effective use of radio for the benefit of the home was brought about when the Peoples Gas Company in Chicago sent for me to stimulate more interest in home cooking among Chicago women, who were contracting the cafeteria habit.

I organized a cooking school, now attended by over 10,000 women per week; and even designed special automobile trucks on which are mounted complete kitchens, and from which lec-

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Illustrating Mrs. Frederick's application of the proper use of radio in the home while at work as well as play

The Conclusion of Our Adventures With Radio in the Canadian Wilderness

By Sinclair Arthur

SO many of my friends have protested against the unprecedented manner in which I left Dr. Hobart and myself in the wilds of Canada, that I feel there is no alternative for me other than a complete account of our sojourn back to civilization. I use the word "sojourn" advisedly. Our trip, from the time we left the Indian camp at the head of Pike Lake, degenerated to an expedition no less thrilling than a familiar visit to haunts commonly frequented by us.

In June, I described the vacation Dr. Hobart and I had planned. From Chicoutimi we traveled across Clear Lake, down the White Water and then stopped to visit the Indian family at Pike Lake. Our Indian guide, Joe, acting as interpreter, explained the marvels of our radio set to the uninitiated savages of his remote lineage. That celebration in the amphitheater that lay below the interlocking branches of the trees, with a venison feast before us, and the tribal dances displayed for our benefit, was an episode that Doc and I will remember to the end of our days. It is an experience worth the trip to the exclusion of all else.

Incidentally, that little party in the heart of a wild dominion was probably responsible for the change that came over us during our trip back to civilization. The nearest I can come to an analysis—in any degree accurate—is the bland assertion that we acquired, that night, a feeling, or sense of familiarity with all things to do with a wilderness as vast and as untamed as we found in Canada. The idea is absurd—I acknowledge it—but there is no other way of accounting for our sudden feeling of kinship with this wild domain.

When we parted with the Indian family, we did so with a feeling that closely resembled occasions in which life-long friends have bid us adieu, preparatory to an indefinite separation.

Our other guide, the French-Canadian, Jacques, promised us what would amount to a glimpse of Paradise. And we were richly rewarded. Across Pike Lake, on a distant shore, a great area of land had been swept by a forest fire, leaving the ground clear for the tender vegetation that is not able to struggle through existence under the thick branches of giant trees. A riot of bright colored flowers covered the hillside in a variegated assortment of inconceivably brilliant shades. On the clear, translucent surface of the lake around us, the delicate tints of the evening's sunset streaked the myriad ripples with ever-changing combinations of crimson and blue. A faint odor of pine and spruce drifted across the water. The even cadence of the paddles lulled our keener perceptions, and called to mind the many stories of fairyland romance and adventure, learned in the days of early boyhood. The setting was perfect for a radio concert.

In spite of the fact that this radio of ours was a burden on the portages, the guides had become enthusiastic over its presence on this trip. In fact, Jacques annoyed me at times with his insistent demand for more music. During the summer months, the days in Labrador are long, darkness approaching seldom before 10:30 P. M. The long evenings were therefore the more enjoyable because of our radio.

Camp had been pitched on the shore early enough to have a long rest before the next morning's portage. Everyone, including the Doc and myself, worked terribly hard on the portages, often carrying more than we could support, and stand upright under the load. The full evening's program had been received from CKAC. The broadcasting of Ilo, the new international language, particularly engaged our

"We found an isolated farm hewn out of the great forest"

interest as a subject worth while.

After we had turned in for the night, Dr. Hobart and I lay for awhile musing over the strange sensation of feeling so much at home in our wild surroundings, and yet, always with the recurrent knowledge that we were several thousand miles away from our real habitation.

WE WERE suddenly awakened. Something was wrong—I knew it—but I couldn't grasp the full import of the situation. A voice pierced the utter blackness. It was the Doc. I jumped to my feet, fully awake. The raging elements had torn our tent loose from its mooring. Rain swept through our belongings—pelted our faces with needle-like intensity—whipped through the tree branches above with a swishing roar, heightened by the drone of the wind. Rain poured down our necks, soaked through our clothing, and washed about our feet in small torrents.

"Are you there!" Doc yelled.

Above the roar of a nature gone mad, the guides' voices pierced the night: "Stay where you are! You move—you get loss!" In a moment, Jacques was at my side rolling our supplies and equipment into a blanket. He explained later that he had done that merely to keep them from being blown away or misplaced in the confusion. At the time, I thought he was trying to keep them dry. Such an attempt, obviously, would have been preposterous.

Jacques clutched my sleeve. "Pardon, M'siere," he said, "we mus' put the tents together, yes?"

I opened my mouth to reply. Water immediately ran in, causing a spluttering of words. "Yes! anything!" I gurgled.

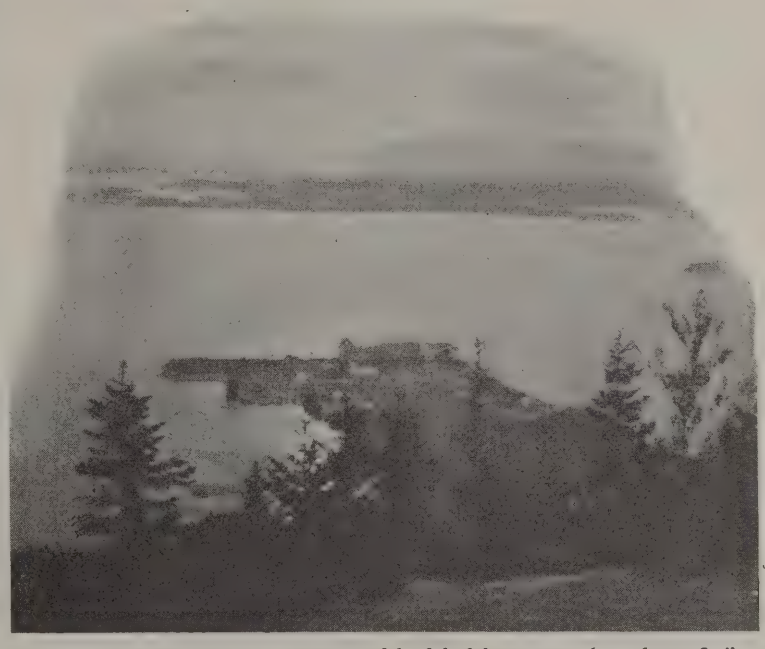
Doc heard it and laughed—or rather, I should say, started to laugh. It ended in another splutter that pleased me immensely. He should have had more decency than he displayed under such trying circumstances.

Jacques and Joe finally succeeded in getting the two tents together in the general form of a wigwam, with an opening at the top. A blazing fire was started in the center and we all gathered around, our clothes hanging on improvised racks to dry. With the increasing warmth of the fire, some cheerfulness returned. Enough clothing was at last dried to wrap about our persons. Strange, that a small thing like garb should be responsible for the return of confidence and the regaining of a vast amount of our lost dignity.

Doc wanted to try the radio, and since nothing would satisfy him until he had been convinced of the futility of the idea, the receiver was retrieved from the pile of equipment and set up for the experiment.

Joe, the Indian, wanted to know what Doc was doing. "DX hunting," I explained. Joe's eyebrows lifted slightly. I explained further that DX hunting was a mild form of the old, royal game of hunting the whiffle-poof in the jungles of America, but Joe's eyebrows remained up, and so I decided to leave them there.

When Dr. Hobart found that the radio could not pick up anything at that hour of the night, we all settled back, lit our pipes and began to tell stories.



"On a distant shore a great area of land had been swept by a forest fire"

Jacques had the best story of the lot. Although he told it as an actual experience of his, I am passing it on at its face value.

It seems that he lost his canoe a thousand miles from the nearest town. To walk that distance in the Canadian wilderness is a dangerous undertaking. But with the fortitude (of one telling a story), he set out on his long journey back. In a couple of days he became very hungry, and since he only had one shell left in his gun, he had to wait for a good chance to get plenty of game with the one shot. He saw two partridges, one sitting on a low branch near the tree, and the other perched some distance to the right on a higher branch. Jacques said that he had grown so hungry, he decided to take the chance with his one shot. He killed the two partridges, but, as he put it, he had to jerk the gun over quick in order to hit both birds.

After three more days of wandering, he found a small lake full of geese. He slipped into the water, and swimming around among them, tied their feet to his belt with a line that he happened to have in his pocket. His greediness, however, resulted in tying himself to too many of the fowl. Alarmed, they rose into the air carrying him with them. And, he concluded, in order to get back to earth he had to pull the geese, one by one, down to him and kill them. In that way the few remaining birds were weighted down to such an extent that they were forced to land gradually, which they did without injuring him in the least. And, needless to say, he had enough food to get him back to the nearest trading post.

OUR little party, none the worse for the storm, reached the low, rolling tundra land of northern Labrador. Rank vegetation and dense swarms of gnats and black flies tormented us nearly to the point of distraction. We were certainly glad to turn around for the trip back to the forest-land. Even our radio refused to work efficiently so far north, although I'll admit that our distraught temperament might have been the real trouble. The tundra of northern Labrador is so vast, and so difficult to navigate, no one has yet been able to make the trip across them.

On our way back we found an isolated farm, hewn out of the great forest. Just why anyone should wish to live in such a place the year round was beyond our powers of imagination. The farmer, a rather unfriendly individual, did consent, after some bargaining, to haul our canoe and equipment to Roberval where we could get a train back to Chicoutimi.

This farmer, whose name I have forgotten, irrevocably rejected every attempt made by Dr. Hobart and myself to demonstrate the joy and value of radio. We wondered afterward why either of us should be concerned about this backward individual, and finally arrived at the conclusion that sympathy alone was responsible for our Good Samaritan inclinations.

In Roberval, the people gathered

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The World of Sound

Second Instalment of a series of articles on

SOUND in its relation to RADIO

By John P. Minton, B.S., Ph.D.

Consulting Engineer, Technical and Test Department, Radio Corporation of America, Fellow, Institute of Radio Engineers and American Physical Society.

THE radio broadcasting stations take the sound in the air, change it over into electric currents of audio frequencies and transmit or radiate them into the surrounding space or ether on the high frequency carrier wave. At the radio receiver the detector tube separates out the currents of audio frequencies from the high frequency carrier wave and then feeds them through an amplifier to the loud speaker or head phones where they are changed back to sound. Much has been said for the radio, but relatively little has been told about the sounds themselves which we desire to transmit and receive. It seems appropriate then to consider the question of "what is sound" and to describe, in a way understandable by all, some of the common things we experience in the "World of Sound."

In the world of sound three elements are essential; material objects, the air and the ear. Around us are objects of every description. A moving railroad train, subway and elevated trains, moving automobiles, moving people, the running animals, the flying birds, the grasshoppers, the crickets, the "galloping fish," the charging wild beast, the moving boats, the moving branches and leaves of the trees, etc. I could go on, naming hundreds of objects about us. Those I have named move of their own accord or can be made to move by external means. In moving they produce little quivers, so to speak. These little quivers are often far too small to observe with the eye, in which case other means must be provided in order to detect the motions.

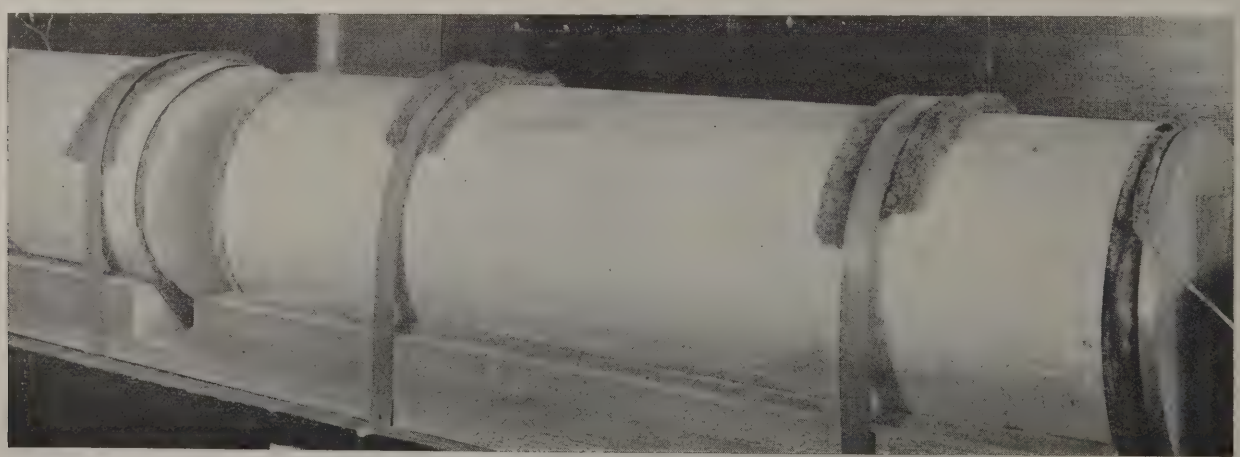
We live in a vast ocean of air and all these objects are immersed in it, so to speak. When these tiny motions occur a corresponding motion in the adjacent air takes place. The motion of the adjacent air is communicated to all the surrounding air and it thus runs in all directions through all the surrounding space, spreading out, weakening as it gets farther away until finally it dies.

It is of the greatest significance to us that the air can carry ever so many quivering motions at once, each motion being independent of the others. We are all familiar with this. The sounds of voices, the music of instruments, the noises from passing street traffic, the rustling of leaves, the singing of birds, come to us all together. We need only concentrate our attention on any one of various groups of sounds associated with any particular object to readily comprehend the presence and significance of each of the various groups.

Besides the movements or quivers of objects and the air, there is another important object, the ear, which performs its function so marvelously in the world of sound.

It is not surprising that we human beings as well as practically all animals have been endowed by nature with organs suited especially to detect and observe these quivers and vibrations in the air. In the first article of this group we described how the ear responds to these aerial vibrations. In this respect the ear is unlike the eye. The phenomena of light are of the universe, but our experiences with sound are those of the earth itself, and so we speak, with perfect correctness, of the World of Sound. If the whole of free space were filled with air or other gases, I wonder what awe and fears we would experience by the myriads of new sounds which would come to us from distant quivering planets, suns, stars, etc. Perhaps we should be satisfied with our own world of sound!

To each of us these aerial quivers which travel throughout the air are of great importance. Through long experience we can easily detect and correctly interpret practically all of them. Let some new and unfamiliar sound come to our ears. How quickly our full attention is focused to interpret it. Does it signify danger—alarm us? For the moment it is of supreme importance to us. It may be the whistling of a bullet through the air, the boom of cannons, volcanic eruption, an earthquake, a falling building, a collision of automobiles, the stealthy step of a wild cat, the cautious step of a burglar. We know them all and per-



The laboratory apparatus used to determine the sound transmission characteristic of various materials—note the slot at left where the material is inserted and then clamped tightly in place

haps, have learned to interpret them because of their significance to us. They are also so different. Indeed, the ear is more wonderful than we give it credit for! It can detect the difference between the voices of men and women, it can distinguish one voice from another. It knows the different inflections of the voice and it can detect instantly and interpret correctly even the spirit that lies behind the spoken word or the cry of the babe! It is everything, almost, to us to be able to converse with our friends and associates, and thus set in motion very special kinds of aerial quivers or vibrations. The world of music also gives great joy and pleasure to many and in this realm, too, special kinds of quivers are produced. Both of the special kinds of vibrations will be treated in a forthcoming article on "Speech and Music in the World of Sound." For the present, let us become more familiar with the nature of sound.

We have seen that the air adjacent to a vibrating object vibrates with it and that these vibrations of the air are propagated throughout the region. In other words, air conducts the sound vibrations, so to speak. We have all watched the water waves traveling along the surface of the water. This constitutes a wave motion passing through water. Sound is a similar wave motion passing through the atmosphere or air. This can be easily demonstrated. In figure 1 is sketched a glass vessel which can be exhausted of the air within it by pumping out the air. An electric bell is suspended within the vessel and is connected to a battery outside the vessel.

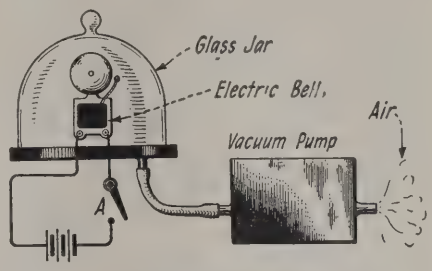


Figure 1—Apparatus used to demonstrate the characteristics of sound

If the electric circuit is completed at A, so that the current operates the bell, we hear it quite easily. We now slowly exhaust the vessel and we observe that the sound from the bell grows weaker. When the exhaustion

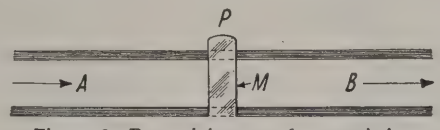


Figure 2—Determining sound transmission through various materials

of air has reached a high degree the sound disappears entirely. This shows that the presence of the air is necessary in order for the sound to be propagated away from a vibrating object. The eye can observe the vibrations of the clapper throughout the whole process which shows that air itself is not needed for light propagation.

This experiment shows that sound will not pass through a vacuum and for this reason no sounds from objects external to our earth can come to us. Air then is the conducting medium for sound waves just as free space or ether is the conducting medium for radio waves and light. This experiment also shows that glass—and other solid objects—not only conduct sounds well, but conduct them without change so that we are able to identify them after they have passed through. When the bell is operating the air is caused to vibrate. These vibrations of the air molecules cause a corresponding vibration of the wall of the vessel by the air molecules beating back and forth against the glass. The glass in turn causes the outside air molecules to vibrate and these motions run throughout all space, a small portion of them acting upon the drum membrane of the ear as described in our previous article.

Sound will also travel through water and other liquids in exactly the same way that it travels through all solids and all gases. During the war great use was made of the passage of sound waves through water in detecting the

Dr. Minton conducting tests with loud speakers in sound proof booth

Exterior view of the portable sound proof booth built especially for acoustic experiments

presence of and finding the location of submarines and other boats. All material objects then are conductors of sound. Some are better conductors than others, just as some materials are better conductors of electricity than others. For example, let sound be passing down an iron tube or pipe, as illustrated in figure 2. At a convenient place, P, the pipe is cut in two and various materials are inserted at the joint as shown by M. Let the sound pass from the section A, through M to the section B. If M is air, the sound in A is practically equal to that in B. For all other materials the sound in B is less than that in A. In figure 3 is shown a group of curves which illustrate how the sound is transmitted through a group of various materials, including ordinary wool felt, soft rubber and lead. The wool felt and rubber were 1/16-inch thick while the lead was 5/1000-inch thick. The curves show the percentage of the sound in A which passes into B through various numbers of layers of the three materials. The curves show clearly that for equal thicknesses the lead transmits by far the least, the soft rubber next and felt the most of these three substances.

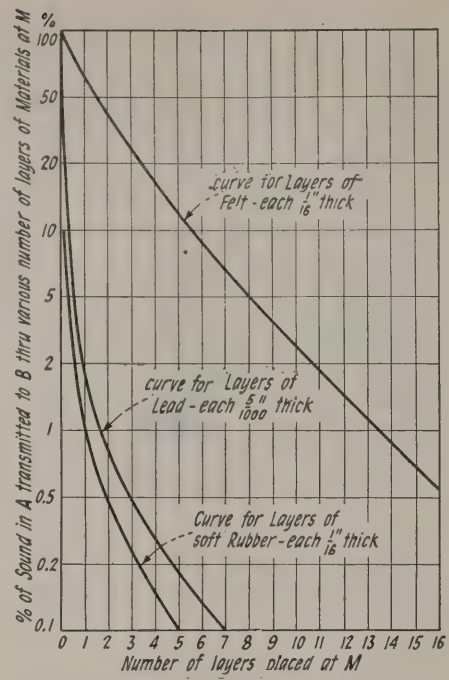

% of Sound in A transmitted to B thru various number of layers of Materials at M
%
100
50
20
10
5
2
1
0.5
0.2
0.1
Curve for Layers of Felt - each 1/16" thick
curve for Layers of Lead - each 5/1000" thick
Curve for Layers of soft Rubber - each 1/16" thick
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Number of layers placed at M

Figure 3—Graphs showing the sound transmission characteristic of various materials

What happens to the sound that does not pass through the material M? Some is absorbed in the material itself and the remainder is reflected from M back into the A section of the tube itself. The heavy or dense materials, like lead are good reflectors of sound, but the light ones, like felt are poor reflectors. We are all familiar with reflection of sound from buildings, from mountain sides, from interior walls of large rooms, etc. The curves in figure 4, show the percentage reflection of sound from materials. The light materials having a density less than one are poor reflectors, but the heavy ones are better reflectors. These curves also show how the high pitch sounds are easily reflected, but the low pitch ones are very difficult to reflect, even from the most dense materials such as copper, iron, etc. That is, low pitch sounds pass right through such materials, but high pitch sounds cannot do so. Then figure 5 shows that the material must have thickness in order to reflect sound no matter how dense or heavy the material may be.

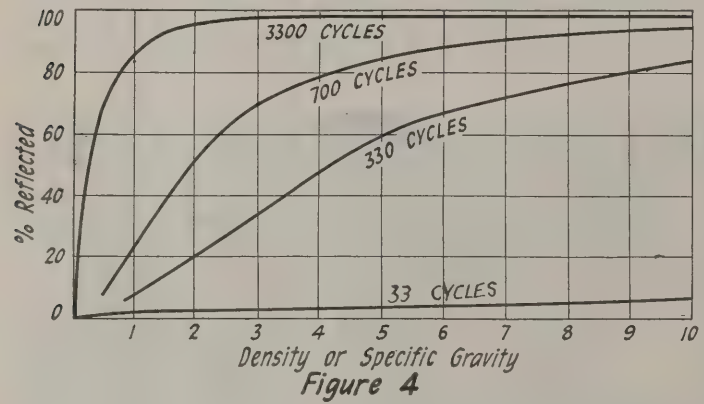


Figure 4

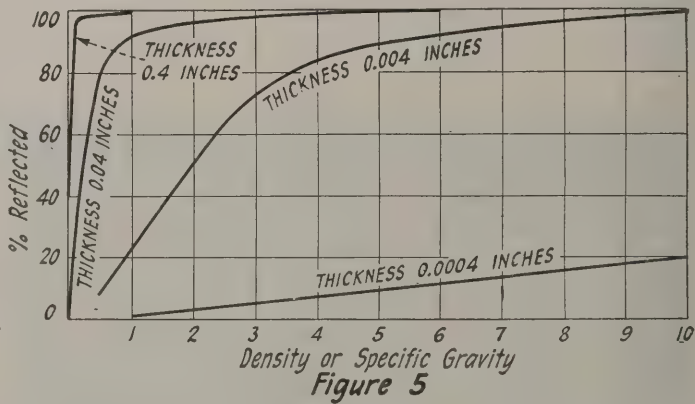


Figure 5

Graphic curves of the characteristics of various materials in sound transmission

Again, the less dense materials, such as felt, cotton, soft wood, sawdust, sponge rubber, rugs, etc., absorb much sound. For this reason they are used as absorbers of sound and are made use of in broadcasting studios, auditoriums and theaters.

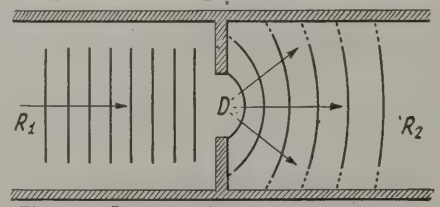


Figure 6—Long sound waves pass through the door D and spread out to fill up all of the room R_2

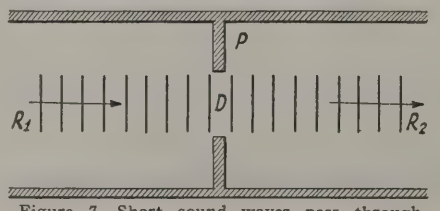


Figure 7—Short sound waves pass through the door D and do not spread out to fill up all the room R_2

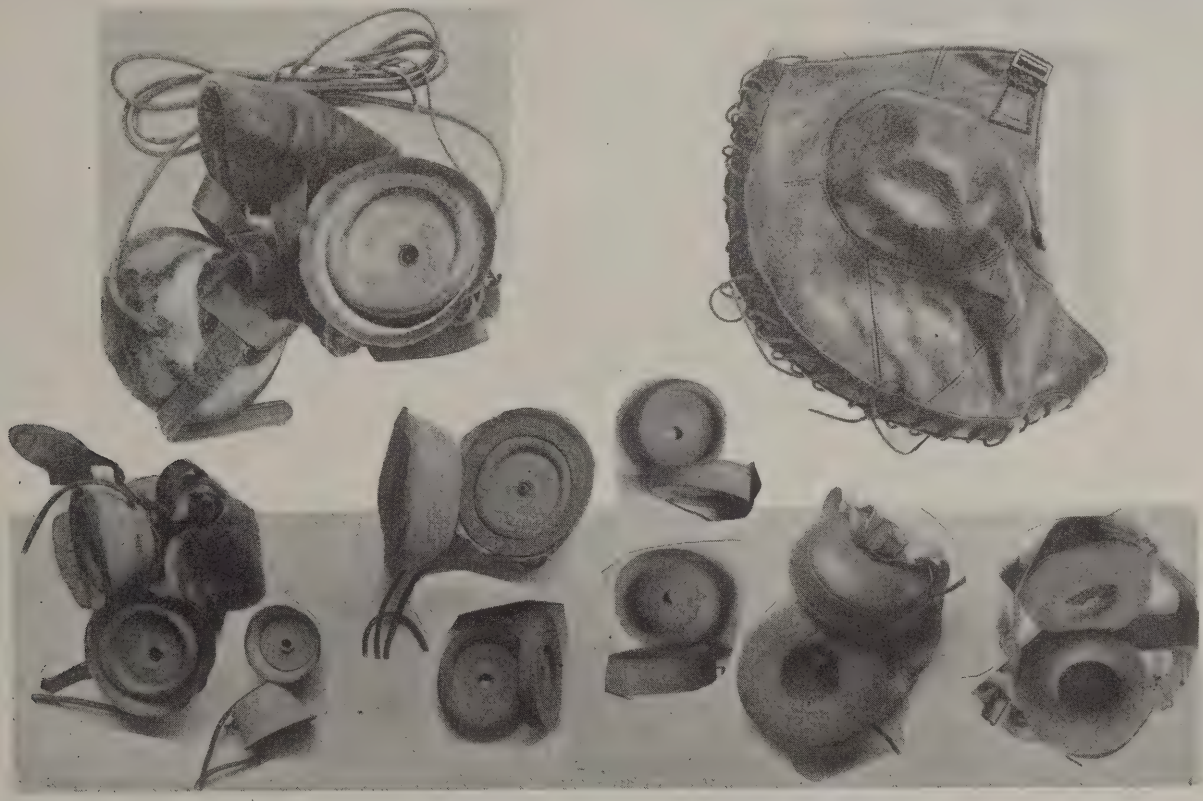
These three phenomena, namely transmission, absorption and reflection of sound play an important rôle in radio. Suppose, for example, it is desired to broadcast the performance of a symphony orchestra. The music is a complex mixture of sounds from all the different instruments, some low pitch ones, some high pitch ones, some intermediate pitch ones and some a mixture of all pitches from the very lowest to the highest. The lowest pitch sounds tend to pass out through the walls of the hall. That is, there is, in a way, no such a thing as a hall for low pitch sounds. The higher pitch sounds are reflected practically 100 per cent. from the walls and windows. Of these the very highest pitch ones are quickly absorbed by the draperies, rugs, cushions and clothing, while the lower pitch of the reflected sound is not so much absorbed. The result is a peculiar combination or balancing of the instruments of the orchestra, with a preponderance of intermediate frequencies which quickly build up in the hall what is known as reverberation and resonance effects. When therefore we broadcast music from halls and auditoriums, this peculiar reverberation effect is readily observable. In studios this effect can be reduced by proper acoustic treatment of the walls, floors and ceiling to a point where it is not noticeable.

These three phenomena also enter in radio for the home. Here again, however, this effect can be controlled and reduced to a negligible point by proper selection of the furnishings of a room. However, if one desires to have the loud speaker in a room apart from the room in which he is located, difficulty of another nature is encountered in addition to these three. In this case the sound will usually have to pass around corners, through halls, perhaps from one floor to another, etc. If sound were a flood of water, it would be possible to get it to fill up every nook and

crevice with sound. The low pitch sounds do act like this, but the high pitch sounds do not. These are more like the water flowing from the end of a hose and go only where we direct it, so to speak, and cannot pass around corners and fill up the space beyond. In other words the high pitch sounds act somewhat like light in this respect.

These phenomena of diffraction of sound waves are represented by the figures 6 and 7. The door, D, connects the radio room R_1 to the listening room R_2. In the case of the very low pitch sound waves, they are long compared with the dimensions of the door and so spread out to fill up the whole of the second room as shown in figure 6. In the case of the high pitch sound waves, they are small compared with the dimensions of the door and so pass sounds will pass from one room to another without much absorption, but the higher pitch ones will be greatly absorbed in their passage along halls from one room to another. Distortion, then, takes place in the original sounds and the effect is not altogether pleasing.

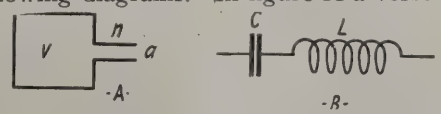
The discussion given above shows how sound energy is propagated and, furthermore, like electric energy along wires or through space as in radio waves, it encounters certain resisting forces which decrease the amount of sound energy that would be transmitted if these forces were absent. All of us are familiar with resistance of the wires, the inductance of the coils and the capacity of the condensers used in radio receiving sets. The acoustical analogies to resistance, inductance and fact that the coil of wire, L, has a certain electric resistance. That is, we cannot divest the wire of its natural electric resistance. Similarly, we cannot divest the neck, n, of its acoustical resistance. The air molecules move back and forth along and in contact with the internal walls of the neck and we all know that rubbing two bodies together requires a certain force on our part and also requires an expenditure of energy as is evident by the heat produced at the rubbing surfaces. This is the corresponding case in electric resistance and is also of the same nature in acoustics. In the electric analogy the resistance is decreased if we increase the cross sectional area of the wire. The same sort of thing holds in the acoustical case — the acoustic resistance, which causes absorption of



Aviator's helmets with their shielded and sound-proof phone receivers made of material determined by the charts in figures 3, 4 and 5

through it without spreading out as shown in figure 7. Consequently if a person is directly in front of the door, he will receive better results than if he stood around the corner as at P. We are all familiar with this effect of diffraction in the case of water waves and many of us are acquainted with it in the case of radio reception. The same phenomenon is observed when large objects are placed in front of a loud speaker or are between the listener and loud speaker. This is why, of course, it is much easier to understand a loud speaker when we are directly in front of it than when we are located in another room.

In addition to diffraction effects as mentioned above, the low frequency capacity may be illustrated in the following diagrams. In figure A a vessel



is represented by v with a neck, n, of small internal diameter, leading from the chamber v to the external air, a. The corresponding electrical analogy is represented in figure B where the capacity, c, corresponds to the air chamber v and the inductance L corresponds to the narrow neck or opening, n. Changes in the magnitude of L correspond to similar changes in n. The same holds true for corresponding changes in the magnitude of C and V.

Now we are all familiar with the acoustic energy, is decreased if the internal bore of the neck is increased. We can also decrease the acoustic resistance of the neck by having its walls perfectly smooth molecularly speaking. This effect of smooth walls however, is of importance only when the bore is small. In ordinary work, like speaking tubes, loud speakers and horns, the effect is of negligible importance.

This analogy is worth carrying further. We also desire to transmit the maximum amount of energy—be it electric, acoustic or mechanical, in order to work at the highest efficiency. In the mechanical case suppose we desire to transmit coal from a Pennsylvania mine to a New York City apart-

(*Turn to page* 88)

Walter Wilson, as "Uncle Bob," broadcasts bedtime stories from KYW

East Meets West in

In Outstanding

EXIT FIREWORKS ORATORY, HIGH LIGHTS OF THE THEATER, THE ROYAL GAME OF CHESS

WILLIAM JENNINGS BRYAN has been a romantic figure in American politics. When occasion demands he can still hold the nation in the grip of his oratorical genius. It is significant that Mr. Bryan should come forward with the assertion that radio has been the greatest invention since the advent of movable type. In the May issue of THE WIRELESS AGE, Mr. Bryan advanced the claim that radio will materially help bring about world peace. Further, he stated that from small candidates up to the presidential nominees each can address the nation the day before election, concentrating their arguments upon the contested issues and answering any misrepresentations that may have been made.

The abuse of so tremendous an influence, he continued, would be so harmful, that the government, acting for all the people, may be relied upon to insure fairness in the use of broadcasting.

Senator Royal S. Copeland had more to say in these pages in the July number. We all know the extent to which radio has been used by President Coolidge in his addresses to Congress. The use of broadcasting during the Republican and Democratic Conventions is now common knowledge. It is, therefore, the employment of that instrument of publicity in the coming election campaigns that most concerns us now.

One notable result is the lesson learned by politicians during the conventions in New York and Cleveland. The old method of oratory, with fist-shaking and hair-tossing, was found to be of small value to B. C. Ls., in some cases, thousands of miles distant. Before the fall campaign opens, some of these gentlemen will probably engage private tutelage with teachers of public speaking.

Dr. Delbert Lean, professor of public speaking at Wooster College, predicts that the radio will do much to improve the literary quality of political speeches. Most of the old-time speakers depend much on their physical appearance, their bodily movements, gesticulations and facial contortions to stir their audience. Any important point was driven home with a resounding bang of the fist on a convenient table. A whole plank in the platform of the opposing party could be dismissed with a snap of the fingers. A shrug of the shoulders was sufficient to make a pigmy of an erstwhile gigantic opponent. Pantomime took the place of logic, and clear English was not necessary if the speaker was sufficiently athletic to dazzle his audiences.

But with the radio these tricks are as useless as an icebox on a Polar expedition. The swaying of the listeners' emotions is secondary to clear presentation of facts. Only the master of English, who depends solely on the power of his words and his ability to use them, will be able to convince.

Will Rogers, in an off moment when he wasn't occupied with coiling his lariat, voiced the opinion that the convention in Cleveland was the first vice-presidential convention ever held in that city. Such remarks have caused the turning of the tide in many important issues of state. Humor livens any serious project. And it should be so. But a happy limit automatically becomes effective in broadcasting. That vehicle of information is too far-reaching for one speech, one catch-phrase, or a single political stratagem to carry undue weight. A first class broadcast station will not allow one party broadcast privileges without an equal advantage open to the other political body. Propaganda is barred; debate is encouraged. Political machines cannot reach broadcast stations, nor control their policies, as they often do other fields of public opinion, primarily because broadcast stations operate without direct return, and will continue to operate without profit in the future. And then, as Mr. Bryan points out, the abuse of such a tremendous influence would be so harmful, that the

The St. Louis Symphony Orchestra broadcast under the

THE GREAT MID-WEST

Broadcast Events

government, acting for all the people, would take active, and probably stringent, measures to insure fairness in the use of broadcasting.

That, alone, is well worth remembering. This presidential campaign will be a broadcast campaign. Tune in on it. As never before, you may rely upon active, individual participation in American politics now that you have radio at your disposal.

Washington led the "straw-foot" brigade in the cause of democratic franchise. Lincoln took drastic steps toward cementing a government run for the people, of the people and by the people. Radio has come to us as an agent of the politic body of America. It is for those of us who will use it.

LENOX ROBINSON'S "Crabbed Youth and Age," second prize-winning one-act play of the Little Theater Tournament, was presented in full, from the studio of station WJZ. The Garden Players of Forest Hills, an organization of non-professional players, has presented some seventy-five productions, both long and short, in the last nine years. Many of their productions have been given out of doors, using the naturally picturesque background of their beautiful gardens. The cast includes seven.

Of the professional plays broadcast by WJZ, "Sitting Pretty" at the Fulton Theater, and "Plain Jane" at the New Manhattan, were big hits.

Queenie Smith as an orphan in "Sitting Pretty," injected spice and mirth

NEW LANGUAGES AND OLD
THE MODERN TROUBADOUR
OMNI - ORAL PRODUCTIONS

into the broadcast performance. Next best was Frank McIntyre, the comedian. Although Eleanor Griffith, as Queenie Smith's sister, had a rather attractive, winsome manner when viewed from the theater seats, much of her real personality was lost over the radio. The garden party ball, which comprised most of the second act, could not be broadcast effectively since too much time elapsed between spoken lines and the following musical numbers. But for the benefit of those who listened in on "Sitting Pretty," it may be said that nothing was lost through hearing only the first of the two acts. The second act is good only if it is seen. The first act, however, happened to be sufficient unto itself fr broadcast purposes.

"Plain Jane" was worth while broadcasting. It is more worth while seeing. Although musical numbers were especially lively and tuneful, and the comedy of the best, the bright scenery and costumes, and the unusually pretty feminine members of the cast, could not be radioed. Described? Yes—but what of it? A broadcast announcer could not do "Plain Jane" full justice. The prize fight in the second act was described, blow by blow, by J. Andrew White, the pioneer "fight" announcer. Incidentally, the "blows" were altogether realistic.

Val McLaughlin, the kiddies "Sandman" broadcasting from WOC

MANY LEGENDS about the origin of chess have been handed down through the ages from dim antiquity. One account runs that an army, long besieged, was in grave danger of broken morale. To prevent the threatening dissension in the ranks, the king had designed a game in which the element of luck would not be a factor. He reasoned that such a game would engage the interest of his men, so arousing mental activity, that each would forget his individual grievances, and thereby regain the confidence that is essential to any project in which a great many have come together for a single purpose. The human weakness for "taking a chance" was soon responsible for the introduction of the practice of casting dice in order to determine which player would make the first move. But chess has come down to us as a product of evolutionary development, always retaining the one great principle—a game well adapted to stimulating thought.

Incidentally, it is significant that the legendary king wishes to stimulate thought at a time when his men, besieged and oppressed, were on the point of revolution. A combination of two thought producers—broadcasting and chess—has been successfully tried and proved popular.

Devotees of the ancient and royal game of chess have used many and

direction of Rudolph Ganz has received enthusiastic response

Upper: R. H. McNee showing his pet Bobcat how to broadcast through station KHJ

Lower: Arthur Murray and Hope Hampton broadcasting dancing lessons from WOR

Both rather typical of East and West

varied ways of playing the game. Great matches have been held by mail, telegraph, cable and telephone.

And now, two of the best chess teams in this country have played their intercollegiate match in the most novel way yet devised—by radio.

Station WIP, Philadelphia, broadcast for the team of the University of Pennsylvania, Station KDKA, Pittsburgh, broadcast for the University of Pittsburgh team.

Both teams had powerful radio receivers installed, the one in Philadelphia tuned to KDKA, and the one in Pittsburgh tuned to WIP. Moves were announced over the air.

Radio-chess enthusiasts were able to watch the progress of this great match as easy as if they were at the game. By placing a chess board next to their receivers, and moving the men as indicated by the radio announcements, they could at all times see just how the game was progressing and who stood the best chance to win.

WENDELL HALL reached Davenport on his tour of eastern and mid-western broadcasting stations as an Eveready entertainer. In his very first appearance at Station WOC, he gained favor with the station's radio audience by ringing the changes of the community's slogan.

"Station WOC," Hall microphoned, "Where the West Begins and Where the Tall Corn Grows," adding, with his famous chuckle, "Sixty Gallons to the Acre."

Iowans liked it and liked Hall. Somebody offered to present him with 1,000 photographs of himself to be offered to his radio correspondents. WOC's management chipped in by standing back of additional requests over 1,000 if the demand were heavier; and the Eveready Battery Organization, under whose direction Hall was making the tour, also agreed to underwrite whatever additional demand might come in.

When he appeared the next evening at WOC, the offer was broadcast.

Hall was scheduled to sing at WWJ, Detroit, the next week; and the week following that, at WSAI and WBAV in Ohio and so on for another month.

He could not wait on at Davenport to receive the mail resulting from his offer. Much as he wanted to, he could not arrange to have it forwarded to him for his personal attention while en route.

It poured in. WOC officials were nonplused. One thousand letters arrived. Then the second thousand. The third! The fourth! Five thousand! And more!

Hall's stay at WOC was one stop on a tour that included twenty-two broadcasting stations. He is the first radio artist to go on an air-circuit. His inimitable crooning of songs to the accompaniment of his ukulele had established him firmly with radio audiences, especially that of KYW, for more than a year before his tour.

In the twelfth and thirteenth centuries, troubadours toured continental Europe, carrying tales of distant towns, disseminating culture, and generally affording welcome entertainment. This originated in Provence, France. From that origin grew many of the social advantages that practically rescued the world from a return to the Dark Ages. The troubadours were an important contribution to the Renaissance Period. Today, we have Chautauqua and vaudeville circuits. Broadcasting, at first, seemed to threaten the existence of those institutions. But such air-circuit tours as that of Wendell Hall's may be another tremendous step forward in the equitable distribution of knowledge that naturally arises from traveling dispensers of that which lies over the horizon and is not to be had except through one who has been there and has seen.

A marked tendency toward local broadcast reception has for long been evident. Local programs, for the most part, can be enjoyed with greater comfort and less effort than DX hunting. It remains for modern troubadours to add the romantic touch to our home broadcast programs. There is much that we can learn from these lyric poets. If they do little more than incite interest, they have accomplished a great deal. We cease to learn at such time that our interest lags.

LANGUAGE is the dress of thought. Ilo is a universal language well adapted to broadcasting. Especially, since broadcast stations have turned to international program development.

The Canadian newspaper, *La Presse*, realizing the importance of an international language, recently gave a course in Ilo which they may now supplement through their powerful broadcast station, CKAC.

Ilo is the result of the collective labor of the world's best philologists and is not a one-man product. Employing the characters of the international alphabet (Anglo-Latin) ONLY, Ilo can be printed, typewritten or telegraphed throughout the civilized world, without alterations or modifications.

Ilo offends no national prejudice, its roots being essentially international: 80 per cent. now known by English, French, Italians, Spaniards, 65 per cent. by Germans, 52 per cent. by Russians, etc. The educated Latinist is not favored at the expense of the general public.

The list of Ilo words is a long one. Thousands of publications in all parts of the world have carried Ilo items. Radio broadcasting stations have spontaneously known the benefits of Ilo to humanity—thus helping to solve, in a practical way, the problem of linguistic intercommunication.

The older international language is Esperanto, and is claimed, by many of its advocates, to be the better for auxiliary international communication. In fact, there is much to be said in favor of both.

Esperantists of France had a thrill recently when they heard brother Esperantists talking from station WIP in Philadelphia. It was announced, prior to the Esperanto broadcast, which was clearly heard in France, that European stations would listen in. The experiment was a success. Esperantists, both in American and Europe, hailed this broadcast of their international language, as one of the biggest steps ever made for the advancement of Esperanto.

Which of the two languages shall be the ultimate preference is hard to determine at this early stage of their development. It is, however, safe to predict that broadcasting will be the necessary stimulus for the eventual adoption of some language, and understood, by all civilized peoples.

STATION WJY presented a new and heretofore untried form of broadcast entertainment, which included our evening performances. For the lack of a better term, they were styled "Omni-Oral Productions." Each performance was of two hours' duration, the invisible curtain rising at 8:30 o'clock on the evening of each performance.

The basic principle of the "Omni-Oral Productions" was to give a radio performance which was a unified whole, in which each act, although complete in itself, was an integral and coherent part of the entire performance. While the "Omni-Oral Production" was primarily designed to please the listener who tunes to WJY at 8:30 and remains so tuned until the conclusion of the program at 10:30, each act was in itself as fully attractive and entertaining as any features of similar nature on present-day programs.

Each performance was opened with an instrumental overture, allowing the invisible audience a "tuning-period" of five minutes. Next came a prologue, appropriate to the general nature of the evening's production and explaining the locale of the acts which were to follow. Then came the various episodes which comprised the evening's performance, each of from fifteen-minute to a half-hour duration, each one varying from its predecessor in type, but dove-tailing in atmosphere and color with all the others. To the announcer was assigned the responsibility of creating the mental-picture scenery which would aid the listener in "attending" the new type performance.

The Wireless Age has proposed something of this nature, editorially. An evening's entertainment constructed with a degree of continuity throughout the program should merit hearty response from listeners in. Such programs would of necessity be prepared with greater care and a deal more thought exercised in making up the schedules.

"A Night with the Conquistadores" opened with a five-minute overture, followed by a brief prologue explaining the nature and locale of the production. A twenty-minute episode of brilliant Spanish and Argentine dance-music, played by one of the leading Spanish orchestras of New York, comprised the next act. Following that, Miss Mildred Delma, the gifted Spanish singer, sang several Spanish Folk Songs, and Vincent De Sola rendered the most famous "Compositions of Spain." Episode III introduced "A Sunday in Caracas," a fascinating reminiscence by Mr. E. E. Plummer, of the customs and manners of that country. In Episode IV the Piedmont Trio, one of the outstanding instrumental organizations in the country, presented a program of Latin American dances. In Episode V a noteworthy group of artists, including Madame Glukerja Campanieskaja, known throughout Europe as "Russia's Greatest Carmen," Eumenio Blanco, celebrated tenor; Francesca Catalina, nationally famous Spanish soprano, and Paul Morenzo, one of the foremost singers of today, presented "Bits of Carmen."

Queenie Smith as the orphan in "Sitting Pretty" broadcast through WJZ

The second of the "Omni-Oral Productions," "A Night Out of the Past," was opened with a prologue. At 8:40 the invisible curtain rose on Episode I, "The Songs You Know." The celebrated Royal Trio was heard in Episode II, singing "Songs of the '60's." Max Kalfus, eminent tenor who has received unusually large response from the radio listeners after his previous concerts from WJY, presented "Songs of the '90's," and George Laval Chesterton, journalist author, traveler, spun some of his fascinating reminiscences in Episode IV. The Temple Quartet, one of the leading male organizations of its type in the East, sang the "Songs of 1900" as the final episode.

"Sport," the third of the "Omni-Oral Productions" presented to the invisible audience by station WJY, commenced with a lively jazz overture. Following the prologue, the Hennessey Orchestra presented a twenty-minute episode of dance music and xylophone solos. The "Dixie Stars," otherwise known as Bernard and Robinson, gave a genuine rollicking "Sing-Song," followed by Episode III—"Three Miles Up" as told by Andrea Peyree, famous French aviatrix and holder of the World's Altitude Record for Women. Upon returning to terra firma, Koty and Abram, one of the most popular teams on radio, sang popular songs and ballads, and in Episode V, Major J. Andrew White re-lived the most famous radio battles he had witnessed. Episode VI consisted of a one-hour dance program.

The last of the "Omni-Oral Productions," "A Night at the Opera," was arranged with episodes and musical numbers selected from operas known best to all. —W. A. H.

RADIO NEWS FROM ALL OVER THE WORLD

Owen D. Young, Mediator on German Reparations

PREMIER MacDonald and Premier Herriot have come to a complete accord on the knotty reparations problem such as England and France have not known in five years.

The two Premiers have put their signatures to a combined program.

Mr. MacDonald yielded to the French demand not to disturb the Reparations Commission's powers, but both Premiers agreed it proper to invite an American to sit with the Commission to decide whether Germany shall have failed to meet payments according to the experts' plan. In other words, they compromised by turning over the power to decide the most delicate question to an American.

The agent for reparations, called the "King of the World" by the experts who drew the plan, will, if the London conference accepts the British and French plan, be in reality the most powerful and most responsible individual in the world.

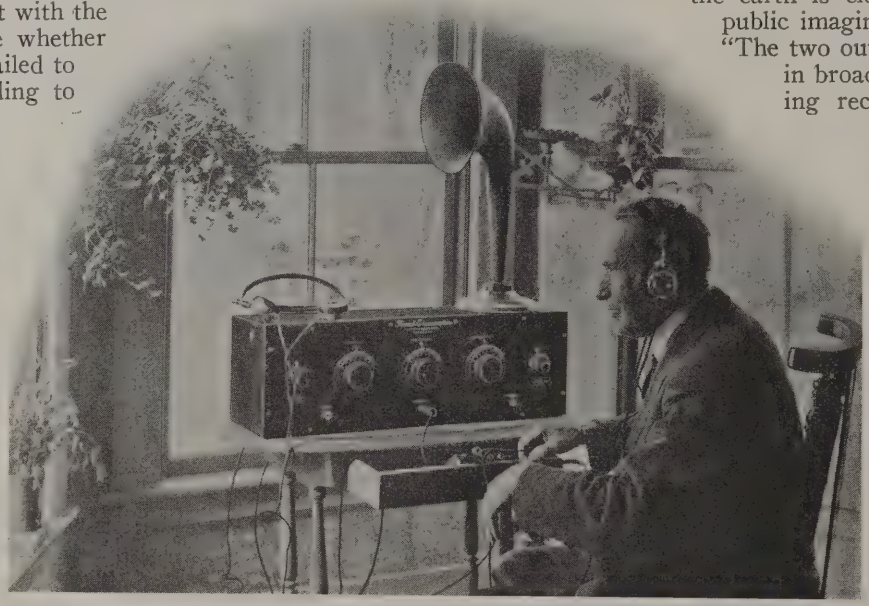
The man they have in mind, if he will accept, is Owen D. Young, Chairman of the Board of the Radio Corporation of America, and one of the American experts who framed the much discussed Dawes plan.

Mr. Young is now in London. He is likely to prove the mediator to put the plan into action, and may some day have it in his power to say whether Germany has failed in her payments willfully.

Seek News from MacMillan

WILLIAM CHOAT, Toronto radio amateur and radio operator for the Canadian Government steamer *Arctic,* which left Quebec, July 1 on her annual trip to Baffin Bay, may be the first amateur operator to relay back to Canada and the United States the complete details of the winter experiences and homecoming arrangements of Capt. Donald B. MacMillan, Arctic explorer.

The departure of the *Arctic,* under the Northwest Territories Branch of the Canadian Department of the Interior, comes at a time when the arrival of daylight in the Far North is beginning to shut off the radio contact between McMillan and radio amateurs in Canada and the United States.



President Coolidge's father, John Coolidge, listening to the broadcast conventions

The radio messages that have come from Donald Mix, the explorer's radio operator, last fall and winter, have become gradually less frequent as darkness began to leave the polar regions. Of late there have been only a few weak messages that have sufficed to show the *Bowdoin's* crew have come through without hardship. The last one told of the explorer's plan to start for home soon.

Predicts Era of International Broadcasting

"WITHIN the next twelve months the farmer in Kansas or Missouri, as well as the city dweller may participate in a demonstration of broadcasting and hear radio programs from Paris, London, South America, and possibly from other parts of the world, as a result of plans of superpower development now contemplated by the great electrical interests of this country," according to David Sarnoff, Vice-President and General Manager of the Radio Corporation of America, in a recent address at the annual convention of the Associated Manufacturers of Electrical Supplies.

"International broadcasting which will link up the furthermost corners of the earth is closer at hand than the public imagines," Mr. Sarnoff said. "The two outstanding developments in broadcast transmission during recent months," he continued, "have been first, the increased power of sending stations under the system of superpower, and second, the advent of rebroadcasting, or the method of linking a number of broadcasting stations so that a program may be passed on instantaneously from station to station.

"We have thus far been thinking in terms of national broadcasting," Mr. Sarnoff continued. "It is a fact, however, that developments now in progress will project the human voice, and programs of music and information across the oceans. I see international broadcasting in the offing. I may say that in the next twelve months or so we will witness a demonstration of it. When the farmer in Missouri or Kansas can actually tune in and listen to voices in London, Paris or Vienna, in South America or the Orient and vice versa, then you will have introduced a new element into the situation which will immeasurably multiply the present benefits and opportunities of radio. To me the real thrill lies in the great humanitarian aspects of radio and its significance not only as a national, but an international factor."

Palestine Turns to Radio

EVEN the Holy Land has succumbed to the radio, "getting distance" now being one of the popular amusements of Palestine, according to a report received by the Palestine Foundation Fund from Jerusalem. The installation of raido apparatus in Palestine was given official sanction by a government ordinance issued on June 3, the ordinance permitting all inhabitants owning their homes to install either receiving or broadcasting instruments.

The demand for radio sets has increased greatly since the issuance of the government order, according to the report. Radio programs are all given in Hebrew, for the ancient language of the Bible has once more become the everyday language of Palestine, as a result of Jewish efforts to rebuild the Jewish homeland. The Jerusalem Opera Company, whose repertory includes most of the well known Italian, French and German operas, all given in Hebrew, furnishes some of the most popular radio program numbers.

The British government is planning to install a powerful broadcasting and receiving station on the Mount of Olives, where Government House, the home of the British High Commissioner, Sir Herbert Samuel, is situated, to keep the Home Office in close touch with Palestine. The Zionist Executive also plans installing a station to reach the headquarters of the World Zionist Organization in London.

North Pole Expedition Radio Equipped

BRITISH wireless fans are much interested in the expedition of the Oxford University men to the North Pole. Their boat, the *Polar Bear,* is the first British craft to set out for the point furthest north equipped with a wireless set.

Hon. Claro H. Recta, minority leader of the Philippine House of Representatives, attended the Democratic Convention and found time to listen-in between sessions

The men on the exploration are delighted with the new arrangement. Already they are counting on listening in to their favorite singers though far from home, and hope to hear the sounds of Piccadilly and Leicester Square even in the land of snow and ice.

Not only the *Polar Bear,* but every sledging party will be equipped with its own hand-driven transmitting apparatus, so that contact between them and their base ship may be maintained.

This year the *Arctic* carries a short wave I. C. W. outfit, which will enable its operator to transmit on the amateur wave lengths between 100 and 150 meters. This equipment is in addition to her two regular sets, consisting of a standard 600 meter 2 kw. spark transmitter, and a continuous wave transmitter working on a 2,100 meter wave length.

The call which has been assigned to the *Arctic* is VDM, while that of MacMillan's ship is WNP. Special permission has been granted for all Canadian licensed amateur stations to use the wave length of 120 meters during specified hours, although transmission on this wave will not be permitted for any other communication.

In order that amateurs will know when to be at their stations for communication with the expedition a definite schedule has been arranged during which Mr. Choat will listen for signals. He will stand watch on the short wave length daily, except Wednesdays and Saturdays, from 11 P. M. to midnight, eastern standard time. Saturday, however, the hours will be extended from 11 P. M. to 3 A. M.

Police vans equipped with receiving apparatus helped the regulation of crowds at Epsom Downs on Derby Day—Orders were transmitted from a captive balloon above the field

Radio Concession in Paraguay Sought

APPLICATION has been made to the Paraguayan Chamber of Deputies by Messrs. Eduardo Rojas & Compania of Asuncion for a concession giving this company exclusive rights to sell radio telephone equipment in Paraguay for five years. It is said, that Mr. Rojas has already obtained the necessary equipment for broadcasting and will place it in operation within six months if the concession should be granted. He contemplates using American material.

Broadcasting in South Africa

ALTHOUGH not actually granted, the Government has definitely promised a broadcasting license to the Associated Scientific and Technical Societies, Johannesburg, for a broadcasting station to be installed in that city.

It is announced that the new station will be installed on the top of the Stuttaford Building, with a broadcasting studio located on the third floor in the same premises. The wave length

(Left) Honorio Pueyrredon, Ambassador from Argentina and (Right) Dr. L. S. Rowe, Director General of the Pan American Union, addressing the invisible audience

will be between 350 and 450 meters. A 500-watt transmitting set will be used.

The Associated Societies' license gives them an area for the collection of fees from listeners extending 100 miles in all directions from Johannesburg and it is expected that the station will be supported by the fees paid in by persons owning receiving sets.

Benjamin G. Lamme Dies

BENJAMIN G. LAMME, Chief Engineer of the Westinghouse Electric and Manufacturing Company, known as one of the "wizard trio" of American inventors, the others being Edison and the late Dr. Steinmetz, died recently in Pittsburgh, Pa., after a lingering illness. He was sixty and had been with the Westinghouse Company since 1889.

More than 150 inventions stand in his name in the Patent Office. He devised the "umbrella" generators that first harnessed the power of Niagara Falls. The high tension system of power transmission, the perfection of the alternating current system, the synchronous converter, railway electrification (applied for the first time successfully by him to the New Haven Railroad), the single-phase alternating current, the high voltage railway system and the single-reduction gear street car motor are among his notable productions.

Thomas A. Edison, Guy E. Tripp, Chairman of the Westinghouse Board, and David Sarnoff, Vice President of the Radio Corporation of America, joined in tribute to Mr. Lamme.

WNYC—526 Meters—Opened

NEW YORK CITY received its share of the air for the first time on July 9, when WNYC, municipal broadcasting station, successfully went into operation. The Police Department Band and Mayor Hylan took turns in the studios on the twenty-fifth floor of the Municipal Building while more than 400 on the roof and thousands in homes listened in.

Mayor Hylan, in a short speech, declared that listeners, by means of the new station, would learn all about New York City if they tuned up to 526 meters, and promised that the new instruments would aid the Police and Fire Departments and do a great many things no station has done before. He added:

"Municipal information, formerly available only after perusal of reports, is now to be brought into one's home in an interesting, delightful and attractive form. Facts, civic, social, commercial and industrial, will be marshaled and presented by those with their subjects well in hand. Talks on timely topics will also be broadcasted. Programs sufficiently diversified to meet all tastes with musical concerts, both vocal and instrumental, featured at all times, should make 'tuning-in' on the Municipal Radio pleasant as well as profitable.

"Through the employment of this modern and very effective means of transmitting information an aroused public interest in the municipal government may logically be expected to ensue upon a broader understanding, a clearer knowledge and a deeper appreciation of its functioning. And it follows, as night the day, that the more enlightened the citizenship the better it becomes."

Foreign Notes

BELGIUM is now approaching the dilemma which must be faced sooner or later by the amateurs of every country that develops an interest in radio. She is in the throes of deciding whether receiving sets shall or shall not be heavily taxed. The legislators have advanced numerous tax plans, any one of which would wipe radio out of the country. But the Radio Club de Bruxelles (The Brussels Radio Club) has raised the battle standard. This Club proposes not only to prevent the proposed new taxes but to abolish the old ones as well.

THE principal station of the Kingdom of the Serbs, Croats and Slovenes has just been inaugurated at Rakovitsa, near Belgrade, the first message sent being an official salutation to the French Minister of Posts in Paris.

ANOTHER conference has been held at Lausanne, Switzerland, and may have as far reaching effects for the future as did the famous political conference held in that city. The recent assembly was one of the national pastors, who have taken up the organization of religious worship by radio. An agreement having been reached between them and the radio people, religious services are now to be broadcast regularly every Sunday evening at 8 o'clock. To avoid schisms and quarrels, the services will be largely evangelical.

PRACTICALLY all the royal visitors to France make it a point to visit the station of Ste. Assise. Prince Taffari, absolute ruler of Abyssinia, made a special trip to this great radio center. From there he thanked all of France for her hospitality to him and his suite while he was in Paris.

HOLLAND, which up to now has been principally famous for her production of bulbs—both tulip and radio—is going to have her first exposition of radio early in September.

AN interesting commentary upon the speech of the King of England, recently broadcast from Wembley, is that a large percentage of the letters received from hearers have been from women. Many have commented upon the splendid modulation of the sympathetic quality of His Majesty's voice. another phase of radio to restore the "personal touch."

International Radio Week

INTERNATIONAL Radio Week will be held November 23rd to 30th, inclusive, according to announcement of the National Radio Trade Association who conducted this event last year and who are making plans for an even greater international exposition of radio progress this season.

Professor M. I. Pupin receiving I. R. E. medal for his research work in radio—Major Armstrong and Prof. J. H. Morecroft, president of the institute took part in the ceremonies

In addition to the activities in the United States among broadcasters and the radio trade in general, Great Brit-

ain, France, Australia, Canada and Cuba will join in the celebration.

In England the various trade associations already organized will have complete charge of the English part of the celebration, while in the other countries special committees appointed by the trade bodies in the radio field will handle the details to make all the special programs dovetail into one another so as to insure the success of this world wide movement.

From London to South America

TESTS made by Senatore Marconi from Poldhu to Buenos Aires in the Argentine Republic have been eminently successful. The first message transmitted was from Señor Le Breton, Minister of Agriculture of the Argentine Republic, who was in London, to General Justo, Minister of War, Buenos Aires. The message was in Spanish of which the following is a translation:

> Marconi, who combines great power of realization with his Latin genius, favors us by selecting Buenos Aires for his first experiment of absolutely direct communication. I avail myself of his generous offer to tender a most cordial salutation to the steadfast defenders of our national flag.

This is the first message which has been transmitted to the Argentine by the Beam system and according to telegraphic advice just received by Senatore Marconi the message was received practically instantaneously in Buenos Aires upon a single transmission.

There is now every reason to expect that there will soon be provided a direct telegraph service from London to the South American Republics insuring the delivery of messages within a few minutes of their transmission and at substantially reduced tariffs.

Radio World's Fair

THE First Radio World's Fair to be held in Madison Square Garden and the 69th Regiment Armory, New York City, September 22nd to 28th, is attracting the radio geniuses of the world and scores of them are preparing to introduce their latest inventions at the coming exposition.

Managers U. J. Herrmann and James F. Kerr have been compelled to enlarge the "New Inventions Section" to a size which will allow the exhibition of one hundred devices. Among the noteworthy American discoveries to be shown will be at least three different instruments designed for the purpose of radiocasting photographs in motion. Europe will also be well represented in this department.

Masanao Hanihara, Japanese Ambassador listens in on the political conventions

Several Continental inventors will display new inventions of a most unusual character. Half a dozen recognized wireless engineers are now busily engaged trying to perfect systems for radioing pictures.

Sixty nationally known manufacturers of the United States will have de luxe exhibits at the Fair and England, France, Belgium, Italy, Switzerland and Austria will have proper representation in the "Foreign Section." Exhibition booths of elaborate construction will fill both big buildings.

A number of the leading radio trade organizations are planning to hold their 1924 conventions in New York during the Fair and arrangements are now being made to conduct their business meetings in the lecture halls and demonstration auditoriums of the Armory and Garden between the hours of 9:00 and 12:00 o'clock every morning.

Fully a thousand jobbers and dealers, native and foreign, will attend the big show and two hours per day will be set aside for the exclusive transaction of business between these wholesale buyers and the exhibitors.

The International Amateur Builders' Contest is assuming such proportions that the show management expects this feature to fill the entire basement of Madison Square Garden. Blanks for this competition are being distributed by radio dealers here and abroad and entries are already coming in from all parts of the world. Twenty-five prizes will be awarded in this contest and entry blanks with full particulars will be supplied to all who write direct to General Manager James F. Kerr, Hotel Prince George, New York City.

Gun Range-Finders in Philippines Use Radio

RADIO spotting from army airplanes aided in the annual coast artillery practice at Fort Mills in the Philippines, the average error of the deviation from the target being only twelve yards at a range of 11,000 yards. So successful was the radio spotting that both artillery and aviation officers plan close co-operation in these annual practices.

The 2d Air Squadron stationed at Kindley Field in the Philippines, acquitted itself with honors in relaying data, and reporting the fall of the shells of coastal rifles from the air.

During the entire practice which occupied over two weeks, not a single radio failure was reported.

Trans-Atlantic Phone Tests

THE 200-kilowatt transmitting apparatus by which the British government hopes to inaugurate wireless telephony conversations with America will be installed about the end of August at the Rugby station. It is hoped to begin the experiments during the following month.

Speaking in the House of Commons, Postmaster General Hartshorn stated that experiments were in progress to test the possibility of establishing commercial telephone wireless between England and the United States. "Spasmodic communication," said Mr. Hartshorn, "has been achieved over extremely long distances, but the aim of the experiments which are now being conducted is to devise a system which will give a reliable and continuous service."

Moose and Music in Maine

A story with a background of reality written by one who has spent many summers in the Maine woods

Story and Illustrations by Stuart Hyde Hawkins

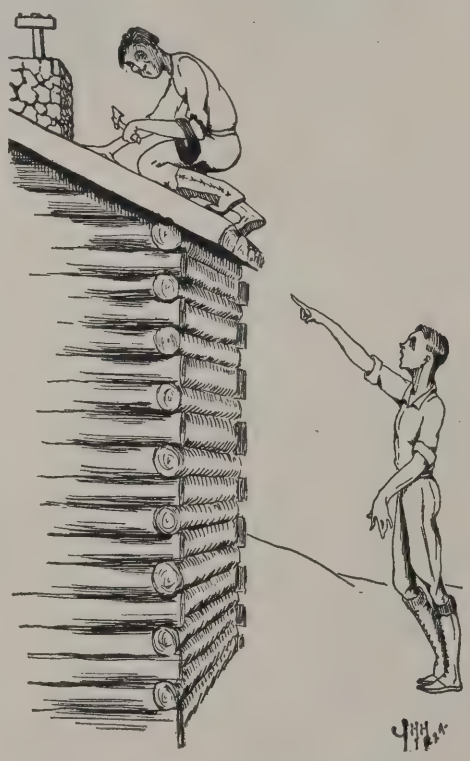
SILENCE pure as mountain water and heavy as winter blankets; silence so absolute that its very emptiness weighed down upon one like a heavy burden; silence so vast, so unbreakable, that one's reason swayed and tottered under the strain, urged by the realization of helplessness and impotence.

I took off the head-phones and tossed them dejectedly upon the smirking radio set before me. Totum pushed my pipe across the table-top and smiled sympathetically. Good old Totum! He had never seen a receiving set before, and never heard this one utter even a squawk, but he had accepted its added weight at the portages without a murmur because I wished it, and now he smiled cheerily because he knew I was discouraged. And I, who had created delightful dream-pictures of his amaze and wonder when I should first tune in a concert, could, in spite of my utmost efforts, conjure nothing but silence from the "greatest DX receiver ever built."

To be sure, the location was a hitherto untried one—a tiny camp, unoccupied for eleven and a half months of the year, on the shore of an absurdly small, but wondrously beautiful lake-without-a-name in the deepest backwoods of northern Maine, but the set should at least have howled with glee as I tickled it, I was sure. I had bought it from an amateur friend a week ago in Portland, where I had joined the old Penobscot Indian who now smiled across the table. Totum, whose real name is a paragraph long and signifies He-who-stares-at-death-and-laughs, had become my summer mentor in the intervals between mowing the lawn and chopping wood at our Casco Bay summer cottage, and had become Totum upon our first meeting. I was aged four when he appeared just after I had been shown my first Indian Totem-Pole. That was some nineteen years ago, and in the interim Totum had initiated me into the mysteries of woodlore and woodfolk on every possible opportunity during the summer months; and we were now on the fifth day of an indefinitely long moose-hunt.

So far the moose had proved effectively shy; at least, we had seen none, and I was beginning to feel that Totum regarded the radio as an ill-omen and a Jonah—provided that civilized Indians adopt the Jonah superstition along with Christianity—while the long evenings which I had planned to enliven with Broadway jazz remained dreamily quiet, broken only by my disgusted epithets.

The failure of the radio was the only fly in the ointment of content, however, and even that could not mar the perfection of the trip. To him who has never experienced it there is an unguessed joy in store in the sheer pleasure of being alive which the Indian Summer days in the virgin forests of Maine can bring. Cool but not cold, with no taint of civilization's ruthlessness, the days fly by in laughing haste, carrying with them regret, not that nothing tangible has been accomplished, but that they do not allow longer time in which to do nothing so well. Naturally we should have liked exceedingly to have seen a moose. The primary object in our coming was to give me a head for the Massachusetts mantelpiece, but we were content to bide our time and let the moose come when they would.



"Totum erected the aerial according to my directions given from the ground"

Dismissing the radio from my mind as the pipe commenced to draw well, I slouched down with my feet toward the rough stone chimney-place and demanded that Totum explain the absence of moose.

"Moose here O. K.," came in slow, careful syllables from behind the cloud of blue tobacco smoke on the other side of the table. "Moose don't like new thingabob, mebbe."

It was what I had feared; his righteous indignation at the twenty apparently useless pounds had at last overcome his politeness, and from experience I knew that nothing would alter his dislike for the silent box.

"Perhaps you're right, I hadn't thought of that," I conciliated. "What do you think of going across the ridge tomorrow and down by Lake Big-Trout—a name of our own adoption, by the way? Maybe if we get away from the box we'll find the moose."

"Uh-huh. Better turn in now, then," was the extent of his enthusiasm.

At what seemed like midnight, but proved to be only a half-hour before dawn, Totum shook me awake and pointed to the already-boiling coffee-pot. In about three minutes—the toilet of a hunter is delightfully simple and quick—I was ready to eat, and as we closed the cabin door behind us the sun was just coming up over Mount Skil-ee-och-nar-ee, which is a poor attempt to render in English the guttural flow of syllables with which Totum designated the pine-covered slope across the Lake-without-a-name. Fifteen minutes' paddling—it was cold on the water and we stroked with a zest—brought us to the other end of the lake, where we beached the canoe and struck off towards the pass over the tiny divide.

Totum never spoke when he was hiking, so my thoughts were my own for the better part of four hours. After the first quarter-mile my interest in the landscape waned, and my boots followed subconsciously in the prints of Totum's knee-moccasins. Walking, particularly strenuous walking, is most conducive to mental activity, I believe—certainly I have always found it so—and my thoughts leaped from subject to subject at random, until they suddenly lighted upon the silent receiving set. In every detail I traced the hook-up, assuring myself that I had done everything which I could or should have; nothing was wrong with the set itself—repeated and thorough investi-

gation had satisfied me on that point. And of a sudden a light burst upon my troubled intellect. Totum had erected the aerial according to my directions given from the ground—and I had gone inside to rescue the potatoes for supper as he was making the final connections. He had appeared in the doorway while I was still at the stove, and had grunted a favorable reply to my inquiry as to whether the task was done. In the evenings which followed I had torn down and rebuilt the set with no thought as to the antenna; and now I was convinced that in the connections on the roof lay the secret of the silence.

Just at that point in my mental peregrinations I heard a grunt of satisfaction ahead, and even as I raised my eyes from the trail I stepped through a fringe of scrub-bush and found myself upon the infinitesimal beach of Lake Big-Trout. Without a word Totum leaned both our guns against a tree and pulled out the home-made pemmican which Totum and Totum alone can make palatable. We munched the bread and meat in complacent silence, while I tried desperately to find a suitable phrasing for the expression of my doubts as to Totum's technical ability. By the time we had finished I had decided not to tread upon the tender toes of his sensitivity, but to wait and investigate for myself upon our return.

The afternoon was devoted to exploration—that heart-breaking routine which is known to every hunter of wild game—and it was not until well-nigh sunset that Totum found moose-signs. We had reached the far-side of the lake, and found a treeless peninsula jutting out from the shore-line for some five hundred yards. Unmistakably the peninsula was being used as a drinking-place by moose—not one moose, but at least three of them; and without a word Totum led the way to a hiding-place in the undergrowth at the southern base of the peninsula and left me lying there with my gun. For an eternity, of perhaps ten minutes' duration, after the stealthy crackling of his moccasined feet had ceased, absolute silence covered the entire lake. His Majesty the Sun, having seen that all was as well as could reasonably be expected of a world inhabited by men, retired rapidly behind the pines to the west, and the lake became imbued with that desolate beauty which dusk in the Maine woods brings. Suddenly an eerie wail, half animal, half human, totally unnerving, shattered the stillness. For a moment my body was a mass of goose-flesh, and I perspired in quaking silence. Then I realized that it was only Totum, calling through his birch-bark moose-horn in an attempt to draw the real moose to the scene. I heard the sound often before—I have heard it many times since—but invariably its weird uncanniness sends an involuntary chill through my whole being.

For perhaps a half-hour the call continued. "Totum must be blue in the face from blowing," I thought. Grayness had almost given place to blackness, the sky overhead was a candelabrum of myriad crystals, when my hair rose on end with a vengeance. An ungainly mountain, with a pine-tree

"Totum stood in the doorway staring pop-eyed over a rather small spread of moose-antlers"

across its crest, stood not two hundred feet away, stamping an impatient pile-driver (one of four) and shaking the branches of its crown nervously. Nobody had ever told me that a moose was large enough to fill a city block! This creature filled the landscape! My gun felt like a feeble pea-shooter as I subconsciously brought it to my shoulder. And then and there I experienced my first real case of "buck fever." Try as I could—although to my startled vision the moose was larger than the entire Appalachian Range—I could not steady my trembling body sufficiently to aim at the vital hinter-shoulder which Totum had so diligently described to me during the past week.

For at least a century I waved the muzzle in small circles, until in desperation I pulled the trigger. To myself I have never been able to state incontrovertibly that my eyes were open when I fired; and when I did see clearly through the haze of smoke the peninsula was empty.

Reviling myself for a weakling and a coward, I strode to where the apparition had been standing and called for Totum. From far away, rapidly going farther, a heavy crackling was audible, proof positive that the moose was unharmed. "But at least he's as scared now as I was then," gave some meager satisfaction to my spirits. Totum had evidently decided to trail him, at least he answered no hail of mine during the next half-hour. And as it was cold and raw on the lake-side, and as my self-esteem was at its lowest ebb, I started for the camp.

That hike was without doubt the meanest one I have even taken! What made me keep on for over five hours through practically pitch-dark woods I do not know to this day. When I finally leaned wearily against the door-jamb of the cabin the moon, rejected mistress of the sun, was gliding down towards the hills in hopeless pursuit of her errant lover. And staring me insolently in the face was the "Silent Six," that paragon among paragons of radio sets! In a sudden burst of resentment—"Couldn't I do anything right on this trip?"—I grabbed the pliers and flashlight and clambered onto the roof.

There beside the chimney lay two bright ends of wire, waiting and longing for someone to unite them!

That done, and done vindictively well, I slid down and threw myself full-dressed upon the bunk.

* * *

I awakened to find it dark, and knew that I had slept through twelve precious hours. Totum was not in the cabin, but his gun, from its accustomed place in the rack, told me that he was within call. As I opened my mouth to shout, the receiving-set caught my eye again, and with that hopeless hope which has suffered repeated defeat I rolled out of bed and crossed to the table.

I figured the time at between seven and ten—I was too sleepy to look at my wrist-watch, and besides I knew it had run down—and was sure that the air was full of radio waves if only

(*Turn to page* 86)

Front panel view of the five-tube Fusidine

The 5-Tube Fusidine

A Receiver That Is Clear in Tone—Easily Tuned—Selective—Not Difficult to Construct—Brings in the DX on Speaker Through Local Stations

By A. H. Cubberly

THE set to be described in this article will more than please you with its performance provided you follow the instrutcions carefully. The author believes this to be the best five-tube set—considered from all angles—that may be made from five tubes without reflexing. It has all of the advantages of selectivity, volume and distance reception and yet it is not critical either in its operation or in its construction.

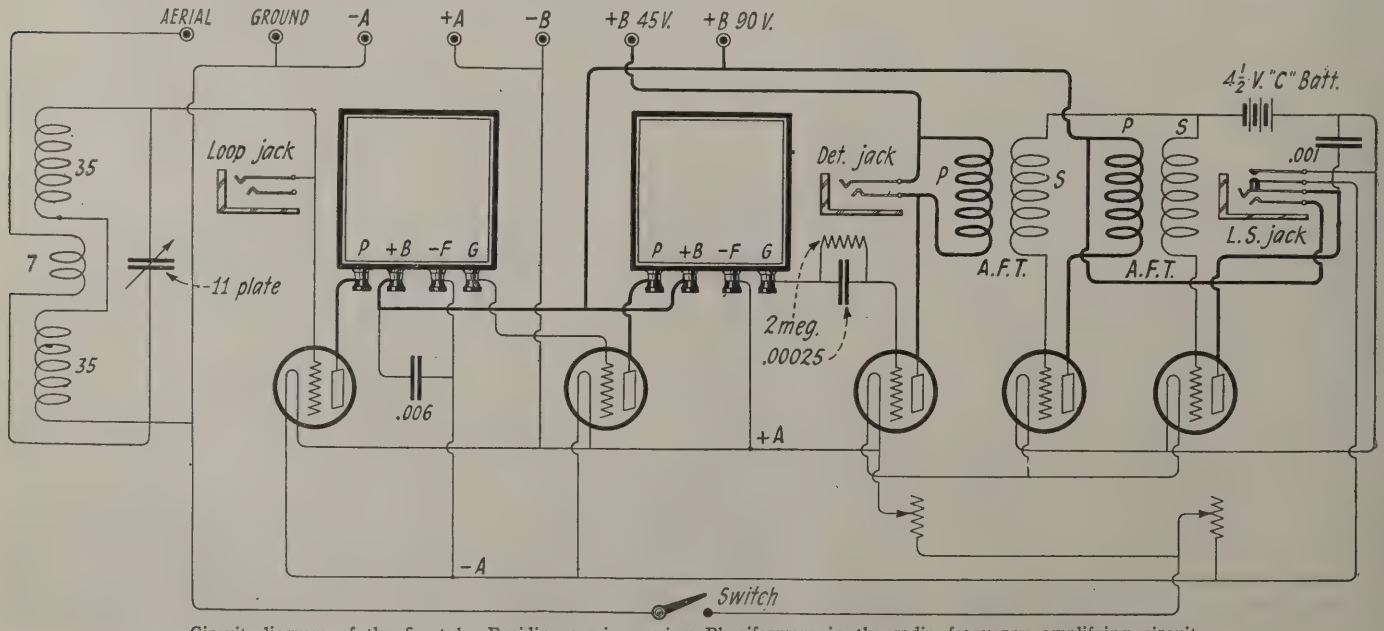
The distance it will receive under favorable conditions seems to be limited only by the amount of interference of local stations, single circuit nuisances, or static and the strength of the sending station. An idea of its selectivity may be had when you consider that with the set operating in the office of THE WIRELESS AGE and with the powerful WEAF station broadcasting from across the street, we were able to tune out WEAF completely and bring in WHN on the loud speaker. Also, in Newark, N. J., we were able to get both WDAP, Chicago, and WSAI, Cincinnati, while WHN, New York, and WOR, Newark, N. J., were broadcasting. All came out full and clear from a Music Master loud speaker. On an exceptionally good night KHJ, Los Angeles, was heard at about 2 A. M. on the loud speaker.

Neither potentiometer or neutrodons are used or required as the set operates perfectly without them.

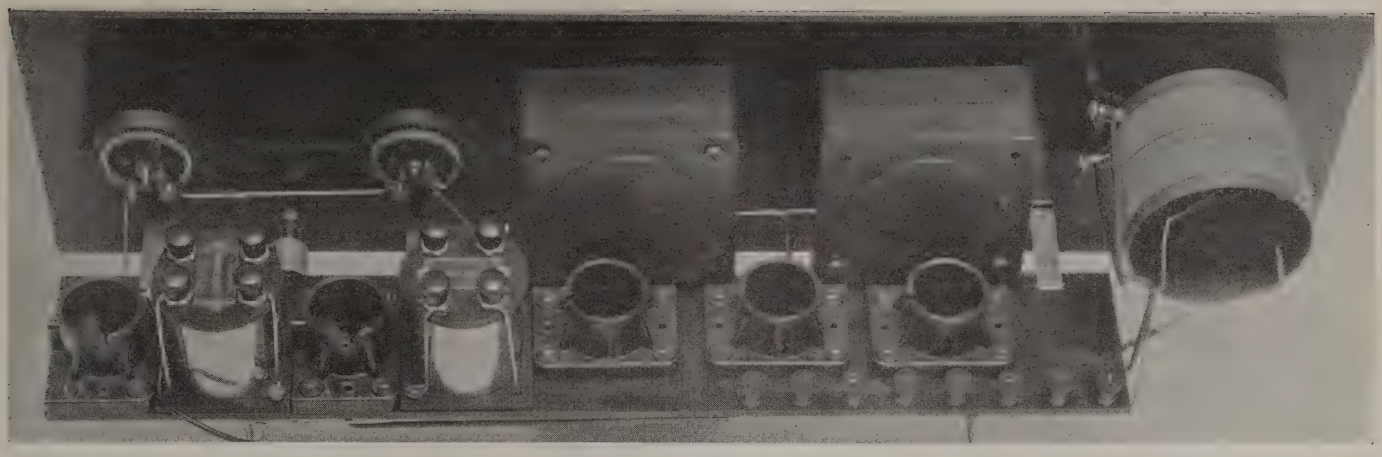
While distance reception comes in

Advantages of The Fusidine.

1. Quality. Reception is clear and perfect reproduction of the broadcasting.
2. Control. All stations once tuned in may be logged and easily tuned in again at the same dial settings.
3. Distance. Brings in distance stations on the Loudspeaker.
4. Operation. Tuning is sharp, but not critical. Operation of filament rheostat is not critical. Set will not interfere with your neighbor.
5. Assembly. There is nothing at all critical about the construction except to follow the wiring diagram exactly.
6. Cost. Is extremely low when quality of reception and actual value of completed set is considered. Appearance of the set will add to the attractiveness of any home.



Circuit diagram of the five-tube Fusidine receiver using Phusiformers in the radio frequency amplifying circuit



Top view of the assembled set showing the tube sockets, a. f. transformers, Phusiformers, tuning coil, etc.

better with long outside aerial and a good ground, local stations may be heard plainly on the loud speaker using only a loop or using an aerial without ground.

An open circuit jack is used on the detector, thus making it possible to listen on the head phones without interfering with the loud speaker. This may be desirable sometimes, as for instance, if the set is located in a store or hall where the loud speaker may be a distance from the set. It is then possible for the operator of the set to listen in while tuning the stations or at the same time the loud speaker is operating. Also it may sometimes be desirable to run wires from the detector plug to head phones at a sick bed in another part of the house from that in which the loud speaker is located.

A filament control jack is used on the amplifier tubes so they will not burn when the plug from the loud speaker is removed.

The following points should be noted about the use of the loop. An open circuit jack is used to plug in the loop. You will see that a connection is made from only one side of this jack to the set when the loop is plugged in. This is done to impress all of the energy from the loop to the grid connection of the first tube. Experiment may prove that both sides of the loop should be connected to the set, but if so, both sides of the loop should be connected to one side of the jack. This may be easily done by connecting the two ends of the loop to the two sides of the plug and then bridging the plug posts with a short piece of wire, connecting them together. The aerial and ground should be disconnected from the set if there is static or other interference when using the loop.

In assembling the set, all parts and jacks, except the two phusiformers, two rheostats and the special tuner and 11-plate condenser should be mounted on the subpanel. The other parts may be assembled on the main panel. The 11-plate condenser for the special tuner may be mounted inside of the special tuner which is wound on a 3½-inch bakelite tube. Verniers are not at all necessary on the three large tuning dials.

MATERIALS REQUIRED

One 7" x 26" x 3/16" Mahogonite panel (Radion).
One 3½" x 21" Black sub-panel (Radion).
One 7" x 26" Mahogany finish cabinet.
One open circuit jack for detector (Federal).
One closed circuit jack for loop (Federal).
One filament control jack for Amplifier (Federal).
One special tuning unit (see details for making).
One 11-plate variable tuning condenser (Pacent).
One bakelite tube 3½" dia. x 5½" long.
One power 6-ohm rheostat (Tillman).
One 30-ohm rheostat for detector (Tillman).
Two Phusiformers (Pathé Red Style or Cosmopolitan).
Two audio transformers, 4½ to 1 ratio (Superior Products Co.).
Five special bakelite sockets (D. W. May & Co., Newark, N. J.).
One filament control switch (D. W. May & Co., Newark, N. J.).
Three 4-inch Mahogonite dials (Radion).
Two 2-inch dials or knobs for rheostats (Radion Mahogonite).
Seven marked binding posts. Aer. Gnd. — A. + A. — B. + B. + B. (Eby).
Three lengths bus wire.
Three lengths high quality varnished spaghetti. (Alpha "Special").
One .006 fixed mfd. condenser (Essex of Newark, N. J.).
One .00025 fixed condenser and variable grid leak (Chas. Freshman).
One .001 fixed mfd. condenser (Chas. Freshman).
One set radio panel marking letters (Qwik-Engravo).
Twenty round head brass bolts 6/32 x 1¼" for sockets.
Twenty small style hexagon nuts for 6/32 bolts.
Six round head brass bolts 6/32 x 1½" for jacks.
Two oval head nickel plated brass screws for mounting panel into cabinet, size about ¾" x No. 6.

The construction of the special tuner is as follows: Wind 35 turns of wire onto a 3½-inch bakelite tube, then skip enough space to allow 7 more turns with a space of one-eighth inch on each side; then wind 35 more turns in the same direction and connect in the center with two wire ends which may be passed through two small holes drilled in the bakelite tube. These ends may then be fastened together and soldered on the inside of the baklite tube, thus making 70 turns in the same direction which is the secondary of the special tuner. Then wind 7 turns in the space in the center, in the same direction which forms the primary of the tuner. Any silk or cotton-covered wire from size No. 20 to No. 26 will do for this tuner. The two outer ends of the primary and the secondary windings may be fastened to binding posts which may be mounted along the ends of the bakelite tube.

The wiring of the set can all be put out of sight under the sub-panel, making a very neat appearance when anyone looks inside of the cabinet. This is easily accomplished by removing the screws from each socket and replacing with longer ones which must be turned down instead of up. The sockets are then mounted on the sub-panel and the wiring is connected from the under side with the nuts that were taken from the sockets originally. The jacks

(*Turn to page* 59)

Rear view showing parts mounted on sub-panel and the wiring underneath

What's in a Name?

introducing
our new name

The Radio Magazine

How do you like it? Here's your opportunity to tell us and perhaps win a $10.00 gold piece :: ::

$20.00 in gold For Best Letters

$10.00 in gold for the best letter, not to exceed 200 words, on why you think our new name "THE RADIO MAGAZINE" is a good one for your favorite radio magazine, or—

$10.00 in gold for the best letter, not to exceed 200 words, on why you think we should retain our present name "Wireless Age"

Choose either side. Contest open to all of our readers. Prize winners will be announced in our November issue. The contest ends September 30. Address all letters "Title Contest," Wireless Age, 326 Broadway, New York City.

AFLOAT AND ASHORE WITH THE OPERATOR

By W. S. Fitzpatrick

DICK JOHNSTONE, popular West Coast radio man and boss of the RCA operators out of the port of San Francisco, attributes his start in the game to the big San Francisco earthquake and fire of April 18, 1906.

While going through the ruins he found some material with which he built his first aerial. Then with a detector consisting of two pieces of carbon with a sewing needle across their tops, a dry battery and a single telephone receiver of 75 ohms, he spent many an hour through the nights waiting for signals from the few ships and station in operation at that time.

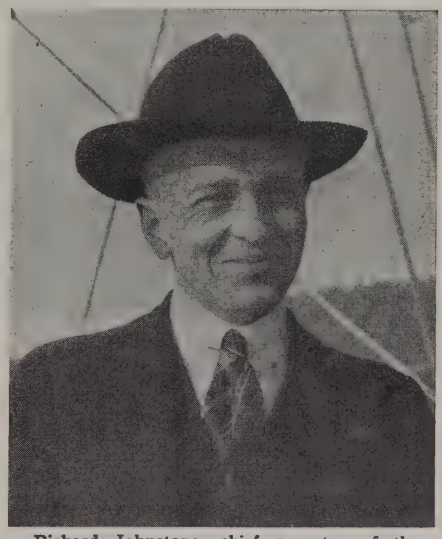
His success encouraged him to improve the equipment as well as his ability to read the code and two years later, in 1908, he heard the Russian Hill station calling Honolulu, then acknowledge receipt of the first message to pass by radio between the Hawaiian Islands and the continent. This incident of the first establishment of radio communication between the Islands and the mainland is a historic one in radio. Mr. Arthur A. Isbell was at the Honolulu end while Mr. L. A. Malarin was at the California station.

Not long after this Johnstone, through added improvements to his station which included a galena detector, was able to pick up Honolulu. He also installed a coil transmitter with which he worked with other amateurs up to a hundred miles away.

He overheard a ship sending a distress call and perhaps it was this that started it, but anyhow, he decided he was going to be a sea-going operator. In the summer of 1912 he obtained a "Certificate of Skill in Radio Communication," which the government issued to all operators during the year previous to starting the regular licenses, and was assigned to the old Pacific Mail liner *Acapulco* as only operator—there were no two-operator ships those days—in charge of a 240-cycle Marconi set, a Fleming valve detector and a ten-inch spark coil.

Mr. Johnstone's first trip was a hard one. Shortly after leaving the Golden Gate for Panama the oil condensers blew out and if it were not for the spark coil he would have been entirely out of business. After several days of real work he had the main set again in operation, but in the meantime suffered the torture of hearing the San Francisco station calling him at a distance of 1500 miles while he was unable to answer. With the Fleming valves on this trip he copied signals up to 2200 miles.

During the three years that followed Mr. Johnstone was operator on several Pacific coast vessels and made twenty-two round trips to Honolulu on the flag-ship *Wilhelmina* of the Matson



Richard Johnstone, chief operator of the Radio Corporation of America's marine department at San Francisco

fleet. On all these trips galena was used as a detector and not once did he or his partner, Edward F. Smith, fail to communicate with San Francisco or Honolulu direct, or through relay in the static season.

At this time Mr. Johnstone's ambition turned toward the famous KPH coast station as San Francisco. To accomplish this end he spent much of his time while in port at the station standing relief watches, and in addition mastered the Morse code which was required.

In 1915 he received an appointment to the KPH station which he held for five years, two and a half years of which were under naval control. In April, 1917, he enlisted in the navy with the others of the station's staff and from then until January, 1920, he was on the circuit, either marine or high power, covering Hawaiian and Oriental traffic.

On February 1, 1920, following his release from the navy, he was appointed storekeeper and in January of the following year was promoted to his present position, that of chief operator of the Radio Corporation of America, marine department, at San Francisco.

* * *

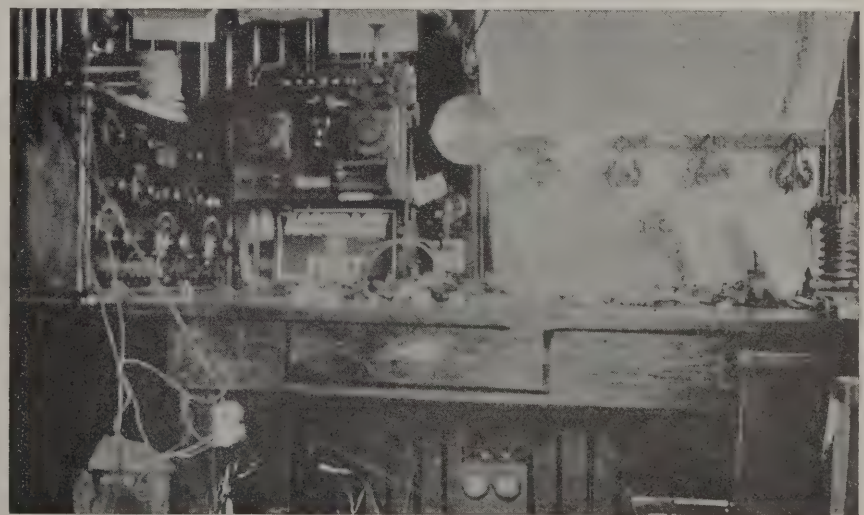
ONE of the interesting reminiscences of Mr. Johnstone is that of listening to his first radio concert back in 1909, when a young man by the name of McCarthy had a wireless phone transmitter on Hayes Street, San Francisco, from which he broadcast songs and music of Columbia records for the entertainment of amateurs. A few years later and long before the present day broadcasting there was a station on the roof of the Fairmont Hotel which transmitted phonograph music to the delight and entertainment of ship and coast station operators as well as amateurs.

* * *

HERE is an interesting letter that came during the month:

"775 Buena Vista Ave.,
"Alameda, Calif.

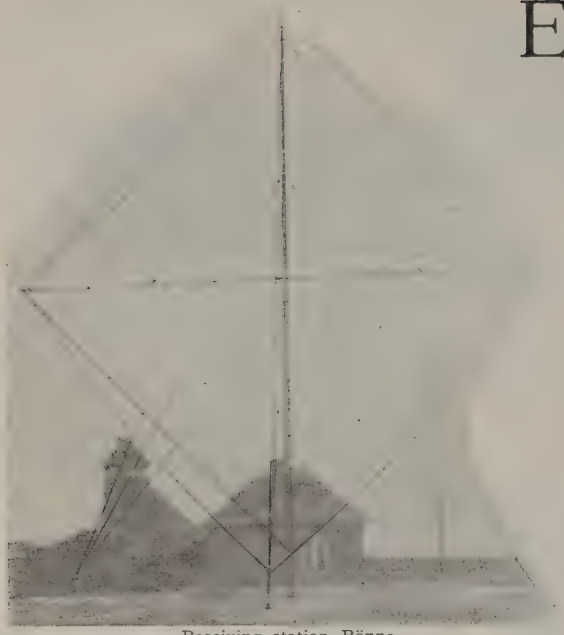
(*Turn to page 92*)



KPH station at Daly City, Calif., as it was in 1914 to 1916 when Mr. Johnstone was operator there

European Over Sea Duplex Radio Telephony

By Dr. Albert Neuburger
Berlin Correspondent for The Wireless Age



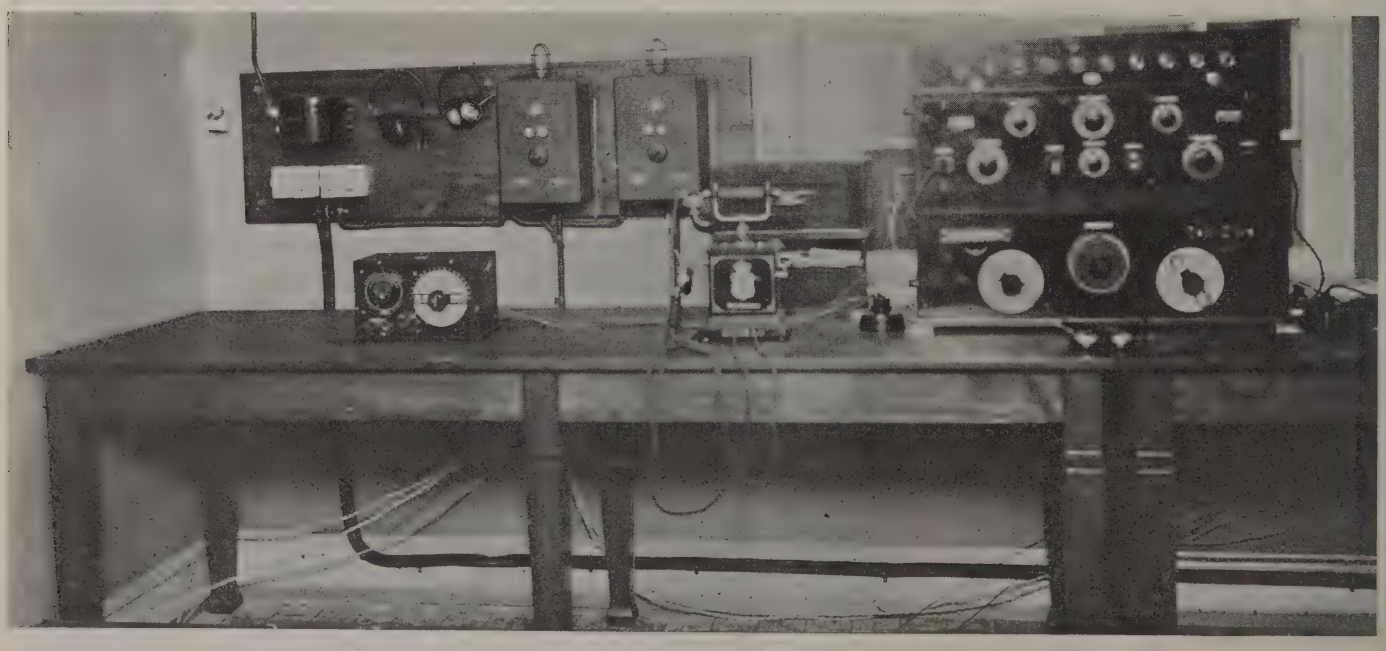
Receiving station Rönne

One of the first European duplex radio telephone stations

THE first radio duplex-line for service between Copenhagen and the isle of Bornholm is now in operation. It serves not only for the connection of that city with the inhabitants of the isle, but also makes it possible for anybody in Denmark to speak with each subscriber on the isle of Bornholm, which is situated in the Baltic and belongs to Denmark. No changes were necessary on the ordinary land line telephone apparatus to connect it in with the radio circuit and the subscribers who speak from Copenhagen to the isle do not realize that they are connected by radio. Only the clearness of the voice, which is better than it has been, marks the improvement that has been accomplished through the use of radio.

When a telephone connection is desired the subscriber in Copenhagen calls in the usual manner for his central-office and gives the operator the telephone number desired. The central-office makes the connection in a few seconds so that conversation may proceed.

The difficulties to overcome in the installation of this system were of different kinds. How to conduct the weak microphone-currents through the telephone network of wires so that it would actuate the radio transmitting apparatus efficiently was one of these problems. On the other hand, the feeble impulses in the receiver must be magnified so that they may be conducted over the land line to the central-office and to the subscriber with sufficient intensity and clearness to be readily heard. This problem was solved by using modern amplifiers and adapting them to this special use. The problem of establishing practical duplex-telephony without mutual disturbance required careful planning. The subscriber using the common land line apparatus is not able to switch from transmitting to receiving on the radio circuit. This difficulty was overcome by devising an automatic distributor which is constructed on the principles of the Wheatstone's bridge.



Interior of the receiving station of Rönne on the Isle of Bornholm

For the Copenhagen-Bornholm circuit the radio transmitter is located at Lingby near Copenhagen. This station works with a Lorenz-Poulsen transmitter. The receiving installation is situated on the isle of Amager in the southwest of Copenhagen. For receiving there is erected a frame aerial which is installed on a 25-meter mast. With this mast there are connected two horizontal tubes, extending out from its both sides which help to bear the antenna. At the receiving station is installed the distributor mentioned above.

The transmitting station of Bornholm is at Hameren in the northern part of the island, while the receiver stands near the port of Rönne at the west coast of the island. The transmitting station at Hameren works with an energy of 0.8 kilowatts in the antenna, also using a Lorenz-Poulsen transmitter.

This new duplex radio telephone works for the present only between Copenhagen and Bornholm, a distance of 150 kilometers. In the near future, however, it will probably be used also for other purposes and perhaps there will be a service between Copenhagen and Berlin, for at the trials made before opening the Copenhagen-Bornholm line tests were successfully made with two-way conversation between Berlin and Copenhagen, a distance of 350 kilometers. It was the first time that the telephone systems of two great cities were connected by radio. Before opening this important radio-telephone circuit between Berlin and Copenhagen international treaties between Germany and Denmark must be signed and therefore it will still be some time before this circuit is opened for public use. During the tests the American steamer *United States* was also successfully communicated with. The captain of the ship spoke from a distance of more than 500 kilometers out on the Atlantic westward from the coast of Norway with a subscriber in Copenhagen. This indicates that the transmitting and receiving stations of the new duplex radio line are capable of being used for other services in addition to the service between Copenhagen and Bornholm.

Radio station at Lingby near Copenhagen

June Conventions and November Elections

(*Continued from page 22*)

the Hudson River called for an investigation which disclosed the startling fact that boatmen, dock hands and longshoremen had deserted their posts to listen in at the various radio stores ranging from Battery Park to 14th Street.

Most of the radio stores had power speakers and the doings in the convention hall could be heard above the roar of passing elevated trains and vehicular traffic.

On the sidewalks of Chicago and the byways of New Orleans, in the Commons of Boston and at the markets of San Francisco, banker and baker and candlestick maker listened to the June conventions. Each interpreted the proceedings according to his ability. Across the land we shall go to the polls and cast our votes, each according to his weal.

THE majority of women speakers at stations WHN and WOR, during the Democratic Convention, were delegates. Women are new in politics. They have not acceded to the oratorical fireworks method of delivery. Consequently, they broadcast well, and shall command a hearing.

Some of the speakers were Mrs. George Bass of Chicago, Mrs. Emily Newell Blair of Joplin, Mo., Mrs. Charles Williams of Washington, Mrs. Solon Jacobs of Birmingham, Mrs. Gertrude M. Pottangall of Augusta, Mrs. Berton McMillan of Tennessee, and Mrs. James W. Gerard of New York. They are a credit to this nation.

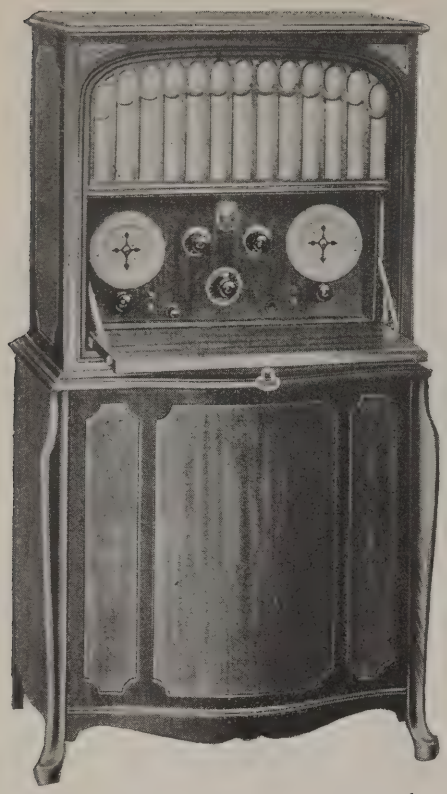
Cool Cal Coolidge sounds well over the radio. Cool Cal delivers a cool, dispassionate speech that sounds equally well over the radio. His success has been attributed to radio. Those who should be able to judge, point out that he has reached millions merely because he talks deliberately, concisely, and is understood by those who listen in.

The cool, confident voice of a woman coming to us by radio is a revelation.

General James G. Harbord of the Radio Corporation of America, has a common sense message for those who want to know how broadcasting the June conventions affects the November elections:

"Broadcasting will give the people cleaner politics and more effective self-expression. Within a month those who have listened in to the great nominating conventions have divided orators into two classes—the old fashioned ranter, the man with the semaphore gestures, the tremulo in his voice, depending on emotional and hypnotic effect, seeing only an audience of a few paltry thousands; and the keen, clear-voiced, self-contained, logical speaker, delivering a message for thinkers listening in by the millions, and not to be moved by the devices of the old style stump speaker. In political matters more than in any other form of human endeavor, archaic methods still prevail. In getting out the vote, either for a cause that is right or a cause that is wrong, office holders with pecuniary interest in the result are still a major influence. Pulling the doorbell, pleading with lethargic voters to go to the polls and do their duty, is hard work.

"Over the broad highways of the ether will come, in the campaign that is now upon us, the human contact between statesmen and people, that will supplant professional politics and mechanical effort at the front door of the voter, with truth and conviction within the home."

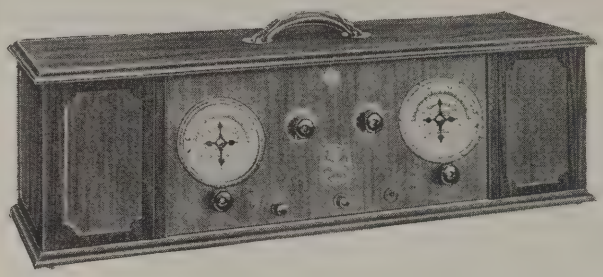


What Selectivity Accomplishes

Another article of utmost importance to radio fans who wish to operate their sets for maximum efficiency

By Dr. Alfred N. Goldsmith, B.S., Ph.D., Fellow, I.R.E.

Director of Research, Radio Corporation of America



The second harmonic super designed for selectivity on broadcast wavelengths

ON a winter's night, there may be passing through the air, waiting to be trapped by a suitable receiver, literally hundreds of radio messages from broadcasting stations, trans-oceanic stations, and marine stations. It is clear that some powerful scientific agency is required to pick out any desired one of these messages sharp and clear, and free from interference from the rest of the myriad of hurrying signals which accompany it. Every broadcast listener knows the practical side of the solution, namely the process of "tuning" his receiver to the desired signal to the more or less complete exclusion of all the other signals.

Every signal has its own wave frequency (expressed in kilocycles) or wave length (in meters). Consider a 750-kilocycle (or 400-meter) signal. In part "A" of the drawing accompanying this article, the tuning dial of the receiver is shown set to this frequency, and the strength of the signal is then "very loud," and is indicated by the height of the dashed-line curve drawn above the scale on the dial. If, however, the incoming signal were of the same power, but of a frequency of 730 kc. (kilocycles), its loudness in the telephones would be less, as shown at the point marked "loud" on the dashed-line curve. If the signal frequency were 700 kc., it would become "readable" only, and if the signal frequency were 670 kc., it would be practically "inaudible." Such a receiver as this would therefore discriminate completely between equal signals, one of which was on 750 kc. (400 meters) and the other on 670 kc. (448 meters). A good crystal receiver will have about this selectivity or power of selection between signals of different frequencies, but the radio engineer would regard this as poor selectivity for any vacuum tube set. Sets employing radiotrons should give much greater selectivity than this. To take an extreme instance of excellent selectivity, the effects shown in the lower portion "B" of the first drawing should be studied. It will be seen that while the signal is very "loud" at 750 kc., remains at practically the same loudness to 755 kc., and then drops very rapidly, becoming "inaudible" at 756 kc.

The type of receiver shown at "A" in the drawing will therefore respond to signals falling within a band of frequencies about 160 kc. wide and has very little selectivity. It will not cut out local interference to any great extent, and its user will have to be content with listening to the strongest of his local stations. The type of receiver shown at "B," however, will respond only to signals within a narrow band of frequency, about 10 kilocycles wide. It has extremely good selectivity. In fact, it is not feasible to improve its selectivity at all without destroying the quality of the music received from an ordinary broadcasting station. Theory and experiment agree in showing that a band of 10 kc. width is required for good musical reproduction, and any receiver that receives a band of less than this width is entirely too selective and will destroy the quality of the concerts received. It was for this reason that the Department of Commerce, acting on the recommendations of the Second National Radio Conference, assigned frequencies to broadcasting stations 10 kilocycles apart so that they could be entirely distinguished from each other by a receiver having the greatest usable selectivity and so that they, in turn would not interfere with each other by producing audible whistling or "beat" notes when they were transmitting.

The following tables give in a general way the degrees of selectivity, or power of distinguishing between signals of equal strength at different frequencies, and the usefulness of each class of selectivity:

Receiver tuned to 750 kilocycles (400 meters).

1. Equal signals become inaudible 80 kc. off tune—that is, at 670 kc. or 448 meters. This is poor selectivity, and will barely enable the listener to distinguish between local stations.
2. Equal signals become inaudible 30 kc. off tune—that is, at 720 kc. or 460 meters. This is good selectivity, and will in general enable distinguishing between local signals and some distant signals.
3. Equal signal becomes inaudible 10 kc. off tune—that is, at 740 kc. or 405 meters. This is very good selectivity, and will meet most requirements of reasonable interference-prevention.
4. Equal signals becomes inaudible 5 kc. off tune—that is, at 745 kc. or 403 meters. This is excellent selectivity, and will meet all possible requirements. It is, in fact, the very limit of selectivity which can be employed with ordinary broadcasting transmission without injuring the quality of music. Greater selectivity than this, therefore, is unusable and undesirable.

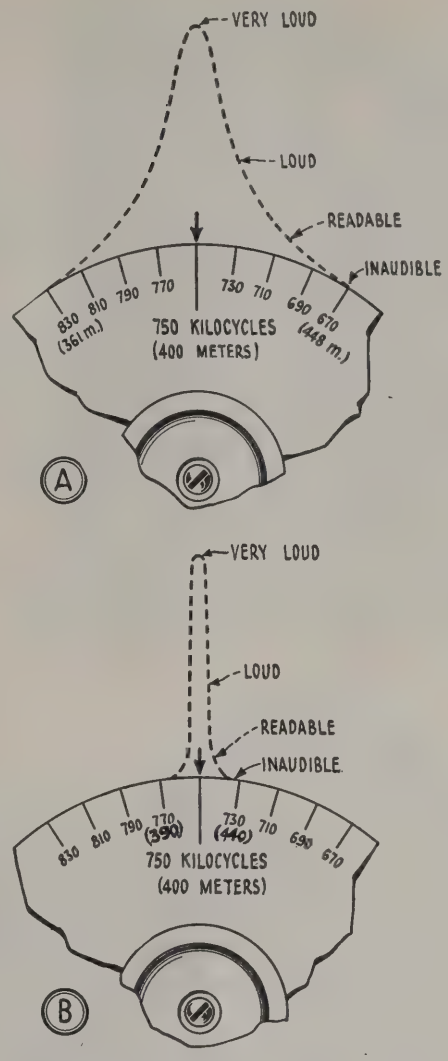
As a general rule it may be said that a good crystal receiver of the single circuit type will have selectivity in Class 1 of the above table; a non-regenerative receiver will fall between Classes 2 and 3 and generally nearer Class 2; a properly used regenerative receiver will be in Class 3; and the obtaining of a Class 4 receiver requires special design and construction. The accompanying photograph shows some of these receivers.

The selectivity which can be obtained from a receiver depends not only on its design, but also on the correctness of its use. Even the best receiver carelessly used will not yield all the desired results. For this reason, a series of suggestions are given below for getting the greatest selectivity from various types of receivers and thus avoiding interference as far as possible:

In using a non-regenerative receiver of the two-circuit type, reduce the value of the coupling between the antenna circuit and the secondary circuit as far as permissible for the desired signal strength. The tuning of the antenna and secondary circuits should then be sharp.

In using a single-circuit regenerative receiver, do not use an antenna any larger than is required to give a loud signal on the most powerful local station when the tickler has been brought up to the point where further increase begins to spoil the quality of the music.

If difficulty with howling or covering the wave length range is experienced under the condition mentioned in suggestion above, place a condenser



Tuning effects of poor and excellent selectivity

across the ground and antenna binding posts of the receiver—the value of this condenser being about five ten-thousandths (0.0005) of a microfarad.

In using two-circuit regenerative receivers, keep the coupling from antenna to secondary circuits as loose as will give the desired signal with tickler adjustment well up toward the point where further increase begins to disturb the quality of the music. If necessary reduce antenna dimensions as well and add a condenser to the set as mentioned previously.

Be satisfied with signals of reasonable loudness.

The selectivity of any type of set being necessarily limited, it is necessary to be content with nearby station concerts if one is located very close to such stations. Distant station reception, if absolutely required, must then wait for the later evening hours.

Ever so often, the broadcast listener will be told of some receiver that picked up a very distant station loudly through powerful local stations on nearby frequencies or wave lengths and without interference. If he cannot duplicate these results, it is no positive reason for discouragement because transmission conditions vary so much from night to night that any general conclusion is meaningless. Distant stations are sometimes amazingly strong and easily received. It is not meant that receivers of high selectivity will not accomplish wonders compared to those having poor selectivity. What is meant is that "one swallow does not make a summer," and that single records prove very little.

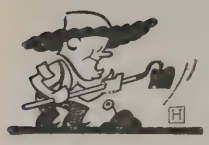
The 5-Tube Fusidine

(*Continued from page* 53)

must also have the bolts replaced with longer ones so they may be mounted on the sub-panel without disturbing the insulation. The jacks are placed upside down and the sub-panel is bolted between the bases of the jacks and the insulating pieces. The shape of the jack springs may have to be changed slightly, using a plug to test them with to be sure that the jack still operates correctly after it has been mounted. As a precaution against blowing out a tube, you are advised to connect the set completely and attach the A battery and try out a tube in each socket before connecting the B battery. A plug must be inserted in the loud speaker socket before the amplifier tubes will light. A wet storage A battery and 201A Radiotrons are recommended throughout.

When the set is completed, the operation is very simple. Be sure the A and B batteries are connected as shown; also the aerial and ground. Insert the phone plug into the loud speaker jack. Turn on the detector and amplifier rheostats until all tubes light, but not strong enough to cause hissing in the phones. Turn the first large dial to any position, say about 30; then rotate both of the other large tuning dials from about 25 to 35 simultaneously. If a station is heard, retune each of the dials for greater clearness and place the phone plug into the detector tube jack and insert the loud speaker plug into the amplifier jack. If no station is heard try changing the first dial up or down about two points and with it in the new position, rotate both of the other two dials about 5 points above or below the number on the first dial. If no station is heard after trial on all of the different points it may indicate that the dials have been incorrectly set on the shafts. These three large dials must be set so they will have the 100 reading opposite the upper mark when the condensers are coupled at maximum capacity or when the rotary condenser plates are fully inside and between the fixed plates.

A peculiar thing about this set is that no sound is heard until you get a station and therefore it is hard to get stations the first time. Especially is this true if you have been using a set that tunes in stations on the "whistle." However, after you have succeeded in picking up a station you should log it as it will always come in on the same dial settings just like the combination on a safe. And what is more, you will not annoy your neighbor while you are operating the receiver.



IN SUMMER TIME

on ships at sea, on ranch and on farm and in many occupations the Weather Man is indispensable around the whole year; but in summer time and vacation time all of us—however sheltered our winter existence may be—wonder from day to day, "What will be the weather?" If we are planning a boating trip it is necessary to get a weather forecast; if a picnic is planned, or an outing of any sort, we must regard the probable weather. A sudden unforeseen change of weather will ruin our day's sport or a week's vacation. Now, whether we get our weather advice through the daily paper or more directly from our radio receiver—which in many remote vacation spots is the only way—we are bound to be interested in Uncle Sam's use of radio and radio broadcasting to increase the service of his Weather Bureau.

Tempering the Weather

150 Broadcast Stations Enable the Weather Bureau to Serve All Parts of the Country and Vessels at Sea in Its Work

By S. R. Winters

A POET living in the sixteenth century wrote, "God tempers the wind to the shorn lamb." Herdsmen on the ranches in Wyoming, in the twentieth century, are safeguarding their shorn flocks of sheep and their offspring from freezing rains by virtue of weather forecasts dispersed by radio. The shearing of sheep and the arrival of new-born lambs are practically simultaneous occurrences and a wintry rain is disastrous to both unless shelter is given during unfavorable weather conditions. Warnings of precipitation by radio afford opportunity for the bringing of the flocks from the open range to the corrals, thus lessening the mortality rate of wool- and mutton-producing animals.

A farmer in Wisconsin upon receiving, by radio telephone, forecast of a cold wave of some duration, communicated with his neighbors and secured their co-operation to the end of scraping and patching the community highway. The road was cut up and in a deplorable state, a condition that would have endured throughout the winter months had the cold wave settled upon it. However, the weather warning by radio telephony enabled the farmers to scrape the bumpy highway and roll a new roadbed in the nick of time. The cold wave, true to the forecast, arrived and the road with its fresh surface froze over. In a measure, it was a boulevard throughout the winter months.

A highway engineer at Carrolton, Illinois, is building a concrete bridge in sections upon the strength of daily weather forecasts received by radio at the local bank, duplicate copies of the bulletins being regularly supplied this bridge builder. A warning of rain may necessitate the employment of an extra force in order to hurry to completion a section of the bridge. He is thus enabled to safeguard his concrete building activities against freezing conditions.

Professor Charles F. Marvin, Chief of the Weather Bureau, United States Department of Agriculture

A fisherman, off the New Jersey coast, casts his nets and seines for the finny tribe in obedience to the storm warnings issued by radio. He writes, "I am interested in the weather prevailing and predicted on the fishing grounds from South Jersey as far north as New England." For a reason not altogether dissimilar, farmers in the vicinity of Peekskill, New York, realize the opportune time for harvesting of hay, lest rainfall spoil the newly cured grass. Likewise, producers of cranberries in the vicinity of Chatsworth, New Jersey, learn of the visitations of Jack Frost by radio. These frost warnings likely insured an adequate supply of cranberry sauce for your Thanksgiving and Christmas turkey.

These testimonials suggest the diversity of interests served in the broadcasting of weather forecasts, warnings, and like information by radio. The frequency of the appearance of the words "weather forecast" or "weather report" in the daily broadcasting programs exceeds that of any other service. Moreover, the Weather Bureau of the United States Department of Agriculture is the only agency, government or otherwise, that has enlisted so many broadcasting stations in disseminating its programs—112 radio-telephone and 25 radio-telegraph stations co-operating.

"Fair and warmer; gentle winds," as commonplace as this phrase and its variations may seem, is of universal appeal. The universal language centers about the weather conditions. The Wyoming ranchman who tends his flock of sheep with the changeable weather conditions constantly in mind

RADIO AND THE WEATHER BUREAU

Radiophone communication has established an epoch in the public usefulness of the Weather Bureau. Great things were done in the disseminating of its forecasts and warnings by means of the telegraph, telephone and cable systems of communication, newspapers and the mails. However, a large part of the public, especially in the rural districts, could not be reached by such agencies, and vessels could not be supplied with vital information after they left port. Radio overcame these difficulties and has become an indispensable factor in the work of the Weather Bureau. Advices and warnings of the Weather Bureau are now systematically broadcast from 150 stations which gives service instantly to homes in all parts of the nation and to vessels at sea.

Charles F. Marvin,
Chief, U. S. Weather Bureau.

and the street-car conductor who exchanges greetings in terms of "cold weather" and "a fine day" are both concerned in forecasts, whether the interest is based on useful application or idle curiosity. Hence, it is safe to assume that music, speech or what not, when dispensed by radio, does not challenge as widespread interest as the condition of the weather on the morrow. The composite interest in weather reports is reflected by the results of a recent survey in which it is computed that 265,000 persons in the United States directly receive forecasts by use of radio. This estimate does not take into account the practice of the operators of radio outfits who distribute the information thus received to their neighbors.

"In my opinion radio offers greater potentialities for the advancement of meteorological science than any other development within the past 20 years," are the words of E. B. Calvert, meteorologist of the Forecast Division of the Weather Bureau, United States Department of Agriculture, in appraising this medium of intelligence for both collecting observations and in the dispersing of forecasts. That radio will be employed eventually as a vehicle of studying weather conditions in remote areas, not now invaded by the cable and telegraph, is implied in the following words of Mr. Calvert which he gave to me in the course of an interview:

"We must secure data as to conditions that are occurring in the inaccessible regions of the north and study them in relation to weather sequences. We know much of the laws in relation to storms and anti-cyclones; about where they form, and the effect of the rotation of the earth on their motions. We know that conditions in one region have a bearing on the weather in another; that a storm over one country today will move to another tomorrow, the next day, or perhaps a number of days later. We feel certain that conditions in and about the polar regions have a decided bearing on conditions of the inhabited regions to the southward.

"The crying need of meteorology is for more information from those places; more reports to form as complete charts for the northern hemisphere as may be possible. It is not to be supposed that telegraph, telephone, or cable lines will ever be advanced into the frozen regions of the north, but it is well within reason and expectation that scientists equipped with radio apparatus will penetrate into these regions, suffer hardships for the sake of science and send daily reports which will mean so much to meteorology and the progress of the world."

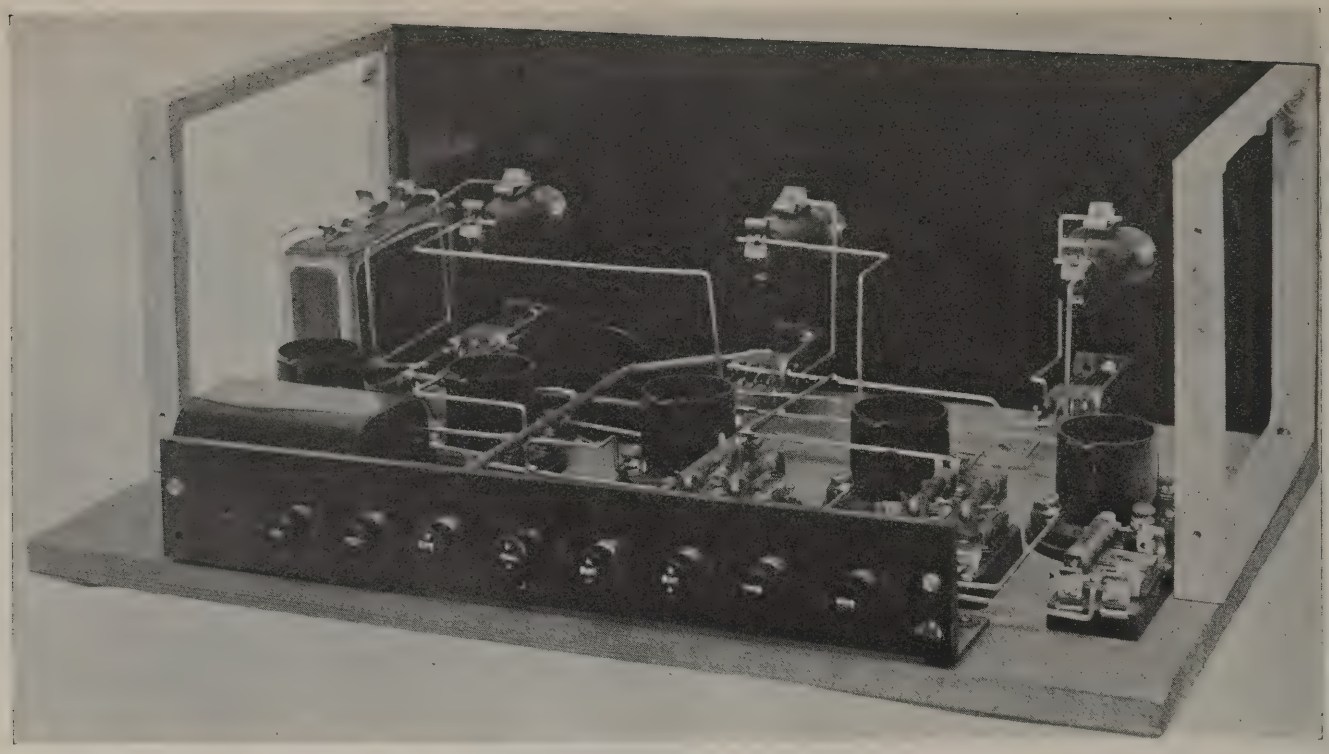
The use of radio telegraphy in the collection of observations pertaining to the weather in areas not penetrated by land-line communication systems is problematical, of course. The application of radio telegraphy in assembling and reporting atmospheric conditions over expanses of water is, however, a reality—in fact, a daily occurrence. Reports from vessels plying the "seven seas" are received with almost the facility and dispatch that observations are made and exchanged by the land-observing stations of the Weather Bureau. Ships equipped with radio apparatus have been enlisted to take and forward two observations daily to the district forecast centers located at Washington and San Francisco. A nominal sum is paid for each observation. However, such substantial corporations as the Texas Company, the Standard Oil Company, and the Texas Oil and Refining Company, in recognition of the value of these storm warnings, make observations and forward them free of cost to the Weather Bureau, except for the radio and land-line tolls.

Happy the farmer who has a radio set. So the weather man can tell him whether rain or sun or snow will come

The extent of the use of radio telegraphy as a weather observer is suggested by the records that 298 individual ships made approximately 10,000 observations during twelve months. This service includes reports of storms and hurricanes over water areas, their intensity, direction of movement and rate of progress. These warnings after being charted are distributed for the benefit of the ships of all nations. Masters of all vessels operated by the Shipping Board are required to take and transmit daily observations, without cost to the Weather Bureau. In a notable recent instance of the alertness of seafaring vessels in reporting the existence of a hurricane, a warning was issued by the Weather Bureau of a hurricane located south of Nassau and Cuba and during the four-day period of the movements of this storm within a certain area 114 observations were made by masters of ships. The meteorologist in charge of the Forecast Division of the Weather Bureau received a letter from a shipmaster indicating that he picked up, by radio, the first warning issued and was thus enabled to chart his course away from the area in which the hurricane was spending its fury.

However indispensable radio telegraphy may be in reporting observations of atmospheric conditions over vast expanses of water, it is not contemplated that this medium of communication will ever displace the Morse telegraph system as a means of collecting weather observations on land. In fact, the 240 observing stations in the United States and Canada are tied into one vast telegraph system, as it were. There are 23 telegraph circuits averaging about 750 miles in length, the longest being 1340 miles and the shortest 231 miles. One of these telegraphic circuits extends from Washington to St. Louis, tying in eleven stations, including Chicago, St. Louis, Springfield, Indianapolis, Terre Haute, Evansville, Cincinnati, Dayton, Columbus, Pittsburgh and Washington. At 8 o'clock each morning the Washington observation is transmitted over this telegraphic circuit and every operator on this telegraph line copies the message. This procedure is duplicated on all of the communication systems until the 240 reports from as many observing stations are distributed throughout the country by 9 o'clock or a few minutes earlier in the morning. Thus this system of collecting obser-

(*Turn to page 75*)



Rear view showing position of parts and the wiring

The SUPER-TONE AMPLIFIER

An amplifier that faithfully reproduces the exact tone quality of incoming signals

By Robert Alan

HAVE you ever wished to throw efficiency and economy to the four winds and forget all the careful habits which you have formed in your experience as a radio experimenter? Most of us have. Have you ever tired of the everlasting substitution of a makeshift appliance for the genuine article in the construction of a radio receiver? If you have, you will appreciate our emotions when we completed the Super-Tone Amplifier.

We have had one ideal. An amplifier that would faithfully reproduce the exact tone quality of incoming signals. This Super-Tone Amplifier is the realization of our ideal.

The ordinary audio-frequency amplifier, using the present-day closed core transformer, can amplify only a limited band of frequencies. This frequency band often fails to amplify the high and low notes on the musical scale. The inherent losses in windings and laminations of the iron core has so far made impossible the perfect audio frequency transformer which rectifies one-half of the alternating current sine. Consequently, these audio frequency transformers were not used in this amplifier, and for the same reason we chose the resistance-coupled, or rather, the capacity-coupled amplifier which makes use of the voltage drop across the resistance inserted in the plate circuit. A resistance-coupled amplifier when properly constructed, amplifies all frequencies perfectly. Therefore, when one is connected to the detector tube we will not miss the notes of a bass horn nor the warbles of a coloratura soprano. This is because the voltage drop across the resistance inserted in the plate circuit through which the plate current flows actuates the grid of the following tube.

The amplification of a resistance-coupled amplifier at so-called audio frequencies, is slightly greater than the amplification of each amplifier tube. Many people are under the impression that in a transformer-coupled amplifier the transformer does all the work and the tube acts only as a coupling. In a properly designed amplifier the tube should do most of the work and the transformer do the coupling. In the case of the resistance-coupled amplifier the coupling is merely a condenser and the tube does practically all the work. For this reason tubes used in a resistance-coupled amplifier should have the same characteristics and be matched. It would likewise be well to have some method of accurately regulating the filament current. This was accomplished with Fil-Ko-Stats in the Super-Tone Amplifier.

Most audio frequency amplifiers have a tendency to amplify tube noises and atmospheric disturbances. The transformer amplifier amplifies to the greatest extent the frequencies of these disturbances. Although more volume is obtained by placing the resistance-coupled amplifier after the push-pull amplifier, by placing these two separate kinds of amplification in the reverse order, stray noises are less apt to enter the final stage of amplification. Consequently, static is not amplified as it is an ordinary transformer coupled amplifier. Although the Super-Tone Amplifier is not a static eliminator, it is certainly a static "diminisher."

Construction Details of the Super-Tone Amplifier

As the majority of the instruments employed in this amplifier are mounted on the baseboard, it is advisable to put all these instruments in place before any work is done on the panel. Five and three-quarter inches from the front of the baseboard draw a line parallel to the front and back of it. This will be the center line for your sockets. The first socket is centered two inches from the left. This is the detector socket. Five and one-half inches from the left fasten the second socket and in the middle of the baseboard mount the third socket. Then using these same measurements locate the fourth and fifth tube sockets. Be sure in mounting the sockets that the two filament posts of each socket are fastened toward the front of the panel so that the filament

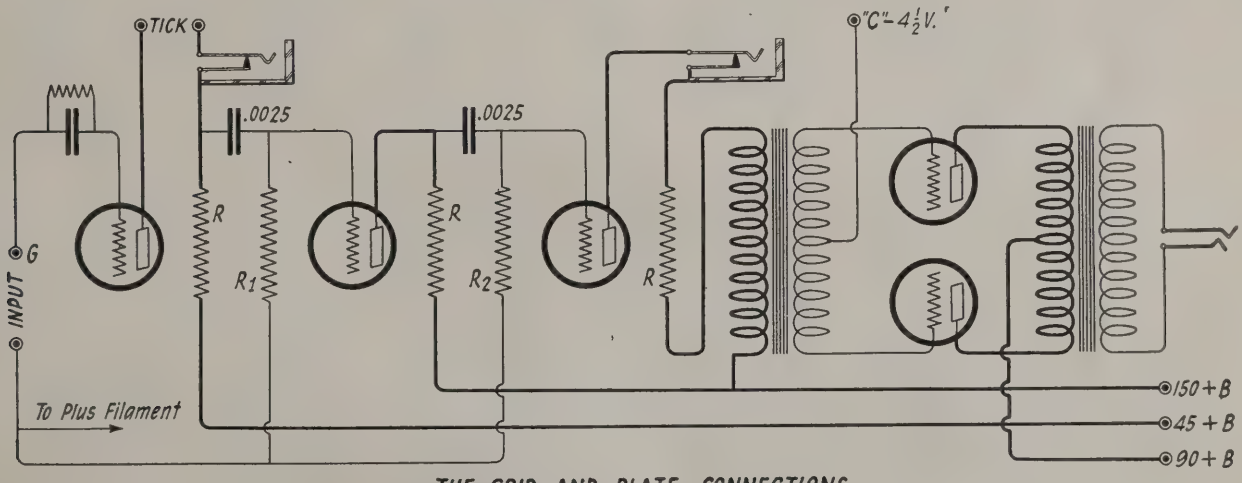
leads will all run between the sockets and the panel. This is necessary because of the connections to be made with the automatic filament lighting jacks. Between the detector tube and first amplifier tube socket and as close as convenient mount the first resisto-coupler and between the first amplifying tube and the second, mount the second resisto-coupler. The grid condenser and grid-leak of the detector tube are mounted directly back of the grid binding posts on the detector socket, so that the grid lead is as short as possible. In the set made up in our laboratory, this lead was not over one-half inch long. The push-pull amplifying transformers are rather large and it is necessary to mount them in the position shown in the photograph in order to have room for them at all. The binding posts, looking at them from the rear, are marked B+ amplifier, 150 volts, B+ amplifier, 90 volts, B+ detector, 45 volts, A+ B— A— C+, plate, tickler, filament and grid. This makes nine binding posts. The Eby posts are admirably suited for use in this amplifier because of the excellence of their make-up and because they have engraved on their tops exactly what each stands for. Start with the grid and plate lead of each socket and make your connections to the binding posts and to the instruments. Leave the filament connections to the last. Next drill the holes for the Quinby frames which are fastened to each edge of the panel. Then drill the holes for the three Fil-Ko-Stats and three Pacent jacks. Draw your center line down the length of the panel three and one-half inches from either edge. The first Fil-Ko-Stat is mounted three and one-half inches from the extreme left end of the panel and the second Fil-Ko-Stat is mounted three and one-half inches from the right end. The middle one, of course, is mounted in the center of the panel. Holes for the three jacks are drilled directly below the Fil-Ko-Stats and one and one-half inches up from the base of the panel.

Now go over the diagram of the filament connections and study them thoroughly before you attempt to hook them up. With a red pencil go over the diagram as each connection is made so that you are automatically checked up if you omit anything. The filament connections on this amplifier are the most complicated of any that you are liable to run across in constructing a modern receiving set. The filament return lead from the tuner is connected to the positive side of the filament. The return lead from the "C" battery in the push-pull stage is connected to the negative side of the filament. The return lead from the resistance-coupled amplifier is connected to the positive side of the "A" battery.

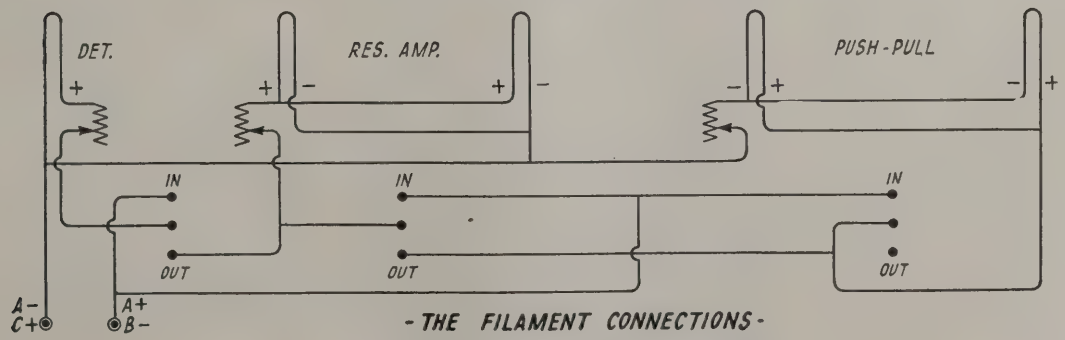
Now connect up your detector jack. Place the tube in the socket and apply six volts to the "A" battery binding post. Turn up the Fil-Ko-Stat, place the phone plug in the detector jack. Now when the plug is inserted in the jack, the detector tube should light up. When it is removed it should break the filament circuit and the tubes should go out. Now complete the filament connections for the resistance-coupled stage and connect up the second jack. Now check up on your movements so far and place the plug in the detector jack. The detector should now light up as before and upon removing the plug it should go out and should have no effect on the next two tubes. Now plug in on the second jack. This should light the first three tubes and upon the removal of the plug they should go out. Next connect up the push-pull stage. When the plug is put in the third jack all tubes should light up and when it is removed all tubes should go out. This method of procedure will check up on any discrepancies in your wiring. Be sure not to make a mistake in placing the resistance and grid leaks. The resisto-coupler posts are marked.

Operation of the Amplifier

The only operating details which are necessary to mention are the matching of the tubes in the push-pull stage and the resistance coupled stage. Pairs of tubes which work well together should be placed in the same kind of amplification. After the filaments are lighted, a careful regulation of the filament rheostat will greatly enhance the clarity of reproduction.

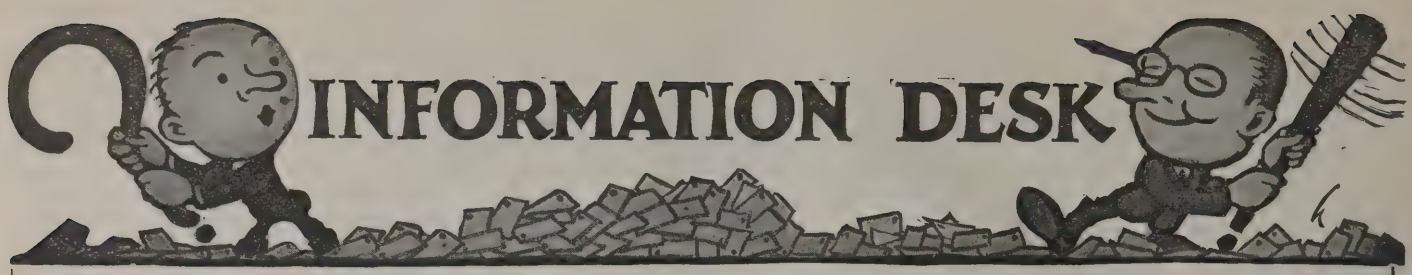


-THE GRID AND PLATE CONNECTIONS-



-THE FILAMENT CONNECTIONS-

Circuit diagram of the super-tone amplifier



CONDUCTED BY R. A. BRADLEY

Due to the great volume of correspondence which this department entails, we are forced to remind our readers on the following points. Be sure to inclose a self-addressed stamped envelope with your questions. Make your questions clear and concise. If you wish information on your set, please inclose a rough sketch of hook-up if possible. Do not ask us to tell you how far your set will receive or how far any set should receive. It is impossible to answer this question as there are too many things which enter into distance reception and too many variable elements to make a qualified statement. Please do not ask us to make comparisons between different makes of apparatus or sets. We printed in the Information Desk for May what we termed an ideal letter. If you wish immediate response to your inquiries, follow the general outline of this letter.

Using the Information Desk

SOME of the letters which we receive in our every day mail show a decided lack of thought on the part of some of our readers. We are sure it is this rather than ignorance because of the absurdity of some of the questions. A short time ago we received a letter in which the writer asked several questions concerning a receiver described in the pages of THE WIRELESS AGE. Among other things he asked us to compare this set with a standard manufactured product, mentioning the name of the manufacturer. Don't you see in what position this places us? We cannot make statements concerning a particular type of manufactured receiver, nor can we uncompromisingly praise a special receiver. This same writer went on to ask what ratio of transformers he should use in constructing this receiver. In this particular receiver there was specified a list of materials used in the construction of the set. We even went so far as to mention the manufacturer which in this case was the Acme Apparatus Co. These people make excellent transformers of one ratio. If the writer had taken the trouble to look up this list of materials it would have been apparent to him that the Acme people make but one ratio of transformer, which they find suitable for all purposes. In most construction articles when special transformer ratios were used it was specified in the list of materials.

Then there is that ever present letter from some of our readers who ask if a certain receiver can be used with UV-199's or WD-12's and so forth. We encourage our readers to read the slip which is enclosed with each genuine Radio Corporation of America or Cunningham tube and to read it carefully. This advises in each case exactly what that tube is best suited for. Every tube on the market that is of standard make, can be used as a detector tube. Of these the best detectors are the UV-200 and C-300. These tubes are especially designed for detecting purposes. They will not serve satisfactorily as an audio-frequency amplifier nor a radio-frequency amplifier. Its sole function is to detect and it does that very well. All the other tubes are more or less "hard tubes," and act best as amplifiers. For a radio-frequency amplifier you should use the UV-199 or UV-201A. For an audio-frequency amplifier the UV-199, WD-11 and WD-12 and UV-201A are all suitable. The WD-11's and WD-12's were not designed for radio-frequency amplification and therefore cannot be expected to do this well.

Then there is the writer who asks if one set will give more volume than another. With the exception of the superheterodyne and the ultradyne, the volume is directly dependent upon the distance of the station from your receiver and the amount of audio-frequency amplification used. If one receiver has a detector and two steps of audio-frequency amplification and another receiver has two steps of radio, detector and two of audio and in each case the same "B" battery and the same tubes are employed and the receiver is located at the same spot, the results if both are properly designed will be practically the same. In other words the amount of pep obtained depends almost entirely upon the audio-frequency amplification and not upon the detector nor what comes before the detector.

Mr. Harry W. Schaller of Oak Park, Ill. asks, Will you please show in your columns a hook-up for an audio-frequency amplifier using one stage of straight transformer coupled and one stage of push-pull amplification including in the diagram the detector tube and a jack connection for an external detector? I have two sets, one with the detector included and one without and I would like to use this amplifier with either.

The diagram you desire is shown in figure 1. The second jack from the left is the external detector jack. By plugging the output of a detector tube into this jack the two stages of audio may be used and by connecting the four output posts of a tuner to the four input posts the whole amplifier and the detector may be used. This sort of an amplifier is a very handy thing to have as it permits the use of either of two sets with the addition of one extra detector tube. And of course the fact that the second stage is a push-pull stage greatly enhances its value in regard to volume and clarity.

Mr. P. S. Young writes that he has constructed the one-tube reflex described in the May issue of THE WIRELESS AGE *and states that he cannot get any station except KDKA, and that not very loud. He advises that he cannot get a squeal except when the variable condenser is turned too high.*

Mr. Young's trouble probably lies in the crystal detector which he employs. If the crystal detector does not make good contact or is out of adjustment, the results will be similar to those he has obtained. The fact that he gets anything at all does not indicate that the crystal is rectifying. The radio frequency tube when reflexed will act somewhat as a rectifier. Mr. Young, we recommend that you get a better crystal detector, preferably an adjustable one.

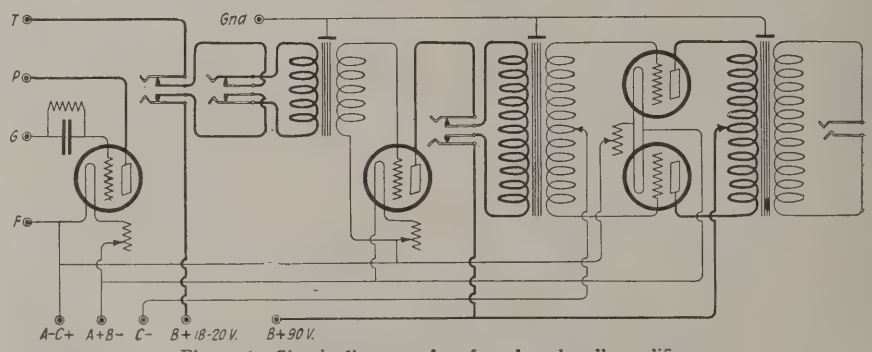


Figure 1—Circuit diagram of a. f. and push-pull amplifier

Mr. Jerome A. McCreary of Westfield, Pa. writes, "Will you please explain to me the action of the plate variometer in producing regeneration in the ordinary regenerative receiver?"

In the tickler coil circuit regeneration is produced by inductive coupling between the grid and plate circuits. This is accomplished by placing the plate inductance in inductive relation to all or part of the grid circuit. The signal voltage after it reaches the plate circuit is fed back by induction to the grid circuit and this feedback is controlled by variable coupling between the grid and plate coils. This action is readily understood. In the two-variometer-vario-coupler receiver the action is somewhat different. The feedback here takes place through the condenser formed by the plate and grid of the detector tube which for a UV-200 is something

(*Turn to page* 78)

Methods of Wavemeter Calibration

Standard Calibrated Meters, "Click" Method, Harmonics and Standard Wave Lengths Used to Construct Calibrating Curves

By Maurice Buchbinder

A WAVE-METER is, as the name indicates, a device for measuring the wavelength of a circuit. Essentially it consists of a coil, or series of coils, and a variable or adjustable condenser. The coils and condenser must be well built mechanically, electrically efficient, and permanent in physical constants, in order that a calibration once performed should be relatively lasting. Besides these essentials the wavemeter may have either a driving device for generating radio oscillations—such as a buzzer—or a detecting device for detecting oscillations in another circuit —such as a crystal and headphones. In either case the particular attached device must be present in the circuit when the wavemeter is originally calibrated else its addition or subtraction will affect the wavelength through its intrinsic capacity.

The best wavemeters used for standards in radio laboratories have no extraneous parts. They are merely coils shunted by fixed condensers, and a switching device for selecting the particular capacity desired and thereby changing the wavelength. Fixed condensers are preferable to the usual variable condensers because the latter are mechanically more delicate and liable to change of form.

For ordinary practical usage, however, our wavemeter will present a number of coils, a variable condenser, and either a buzzer or crystal-headset combination or both. The buzzer would be employed in a circuit such as is shown in figure 1; the crystal-headset in a circuit such as is shown in figure 2. It should be noted that the latter are not connected in the usual way across the variable condenser, but are unilaterally attached. This is done so as to diminish the capacity effect, which, negligible at high wavelengths, is quite large at the lower wavelengths and capacities. If both external attachments are present in the wavemeter a calibration is made in each condition—that of receiving and of transmitting by buzzer.

There are several methods available for calibrating a wavemeter. All methods but two require the use of another accurately calibrated standard meter. It is however possible to use known wavelengths as a standard, instead of a wavemeter. It is the purpose of this article to describe in detail each of these methods.

Standard Calibrated Meter

The simplest possible method is illustrated by means of the diagram in figure 3. A represents the standard meter whose calibration curve is known for use as a driver or source of radio signal. B represents the meter which is to be calibrated, connected for use as a receiver by the unilateral method of connection. In the process of calibration we set meter A at the lowest wavelength, and, using the smallest coil of meter B, tune in the signal coming from meter A by varying the condenser of the unknown wavemeter B. At a certain point the buzz emitted by A will be heard. The location of this point can be sharpened by loosening up our coupling between A-B. Then we know of course, that at this point, whatever the condenser reading of meter B may be, the circuit wavelength is that given by the standard A. We then go on, increasing the wavelength by gradual steps and in about ten readings cover the entire range of wavemeter B for its smallest coil. The same is done for each one of the coils and in that way the whole wavemeter range is covered. After having gone through a calibration of this kind we can reverse the process, that is, receive with the standard wavemeter and listen with the meter being calibrated. Thereby two sets of calibration curves are drawn up for wavemeter B, for use as a receiver and a driver respectively—a smooth curve being drawn for each coil for a condenser range of 0 to 180 degrees.

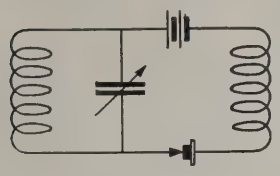


FIGURE 1

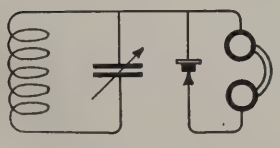


FIGURE 2

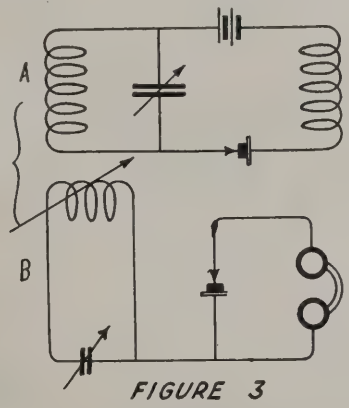


FIGURE 3

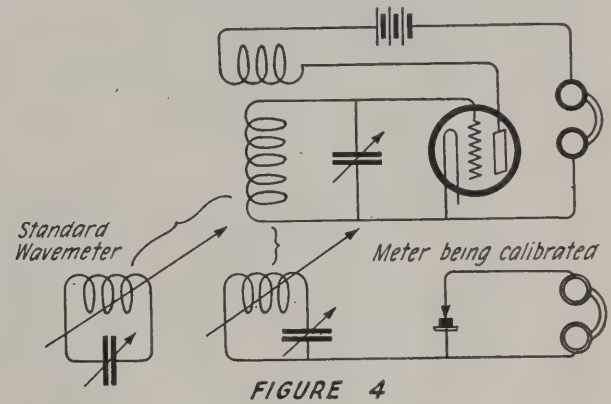


FIGURE 4

Various circuits for wavemeter calibration

Click Method of Calibration

The above method, as already mentioned, is the simplest, but it is not the most accurate. The most accurate method for calibrating wavemeters, because it permits the sharpest tuning, is that which may be called the "click" method. In this procedure use is made of an auxiliary oscillating tube circuit capable of being adjusted through a wide range of wavelengths. It is based upon the following phenomenon of oscillating circuits: If a circuit be made to oscillate and another circuit be magnetically coupled to it, then when the second circuit is tuned just to the wavelength of oscillations, these oscillations will suddenly disappear—and the disappearance will be manifested by a click in the listening earphones due to a change in plate currents. Furthermore, if the coupling between the two circuits be made very loose, then the sharpness of this disappearance will become quite remarkable, the movement of a fraction of a degree of condenser being sufficient of this principle is quite simple. We must have an auxiliary oscillating tube circuit, a standard wavemeter, and the unknown meter which is being calibrated. The standard wavemeter is coupled to the source and adjusted

until the click is heard, the wavelength of the source having meanwhile been kept constant. Coupling is opened up until the reading is as sharp as we desire it. The standard is now removed and the unknown substituted, the process of determining a "click" point being repeated by varying the condenser of the unknown wavemeter. Then we are safe in saying that the wavelength of the standard and the unknown were exactly equal at the time of the click, and the wavelength of the meter being calibrated is thereby determined for one setting. We then go on to vary the frequency of the source and pass through the range through which it is desired to perform the calibration. Data are thereby given for drawing up calibration curves exactly as with the first method. The question arises in one's mind, does not the mere coupling of another circuit to the source, affect its wavelength and thereby lessen the accuracy? But a little thought shows that the method is not dependent upon any constancy of wavelength—although by use of very loose coupling this is practically attained—but on a direct comparison of known with unknown; *i. e.,* any changes will hold for both known and unknown and cancel one another. Figure 4 reveals the method graphically. The unknown meter may be calibrated in a condition of no external attachments, with a driver, or with a headset-crystal combination. A separate group of curves will result in each case.

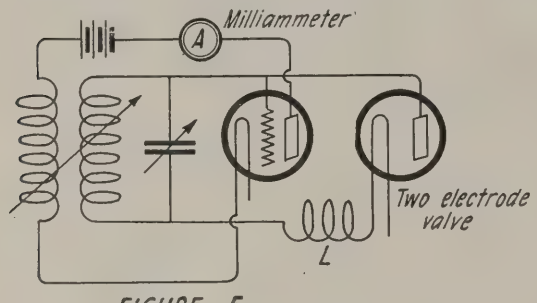


FIGURE 5

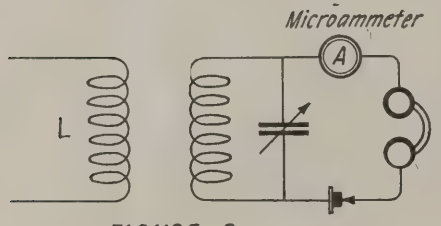


FIGURE 6

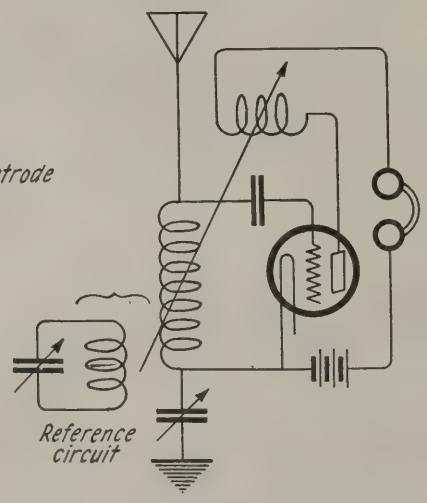


FIGURE 7

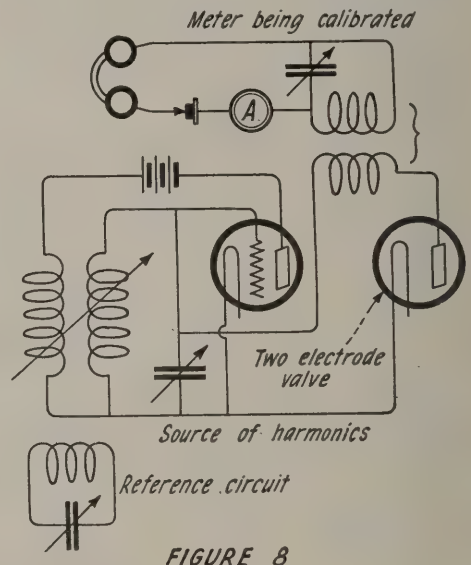


FIGURE 8

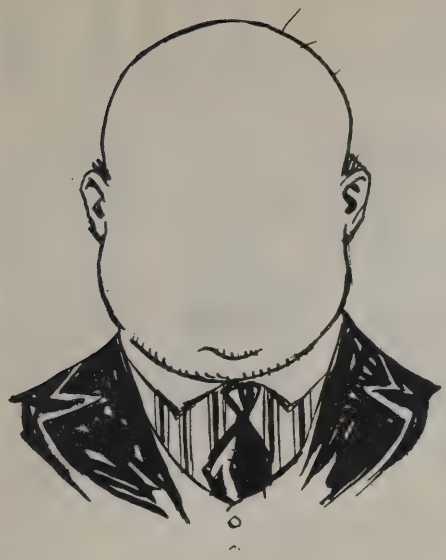
Method of calibrating various vacuum tube circuits

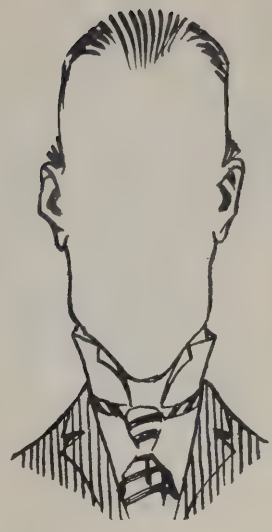
Harmonic Method of Calibration

The method of calibration next to be described can be used by an experimenter without a standard wavemeter at his disposal. It is therefore a particularly valuable and, as it happens, a most accurate procedure. It is not well known that any C. W. oscillating circuit does not vibrate at merely one frequency, but it consists of a fundamental frequency and several harmonics, the number depending upon vacuum tube characteristics and so on. Thus a vacuum tube working at 1000 meters also gives off energy at 500, 333⅓, 250, 200, etc., meters, namely, the first, second, third and fourth harmonics respectively. These harmonics are comparatively minute in intensity, but by suitable methods they are easily made manifest. Theoretically, harmonics in a vacuum tube circuit occur only in case of distortion. The maximum distortion would occur if we entirely suppressed one-half of the oscillation, that is to say, if we rectified the oscillation. It has been shown by mathematicians that a rectified oscillation is exceedingly rich in harmonics. Hence, practically, if we desire to intensify harmonics in an oscillation for a certain purpose, we should endeavor to entirely rectify the oscillation. A circuit which is exceedingly rich in these harmonics will be found in figure 5. It consists of a standard oscillating power circuit. Shunting the condenser of this circuit we find a two-electrode tube in series with an inductance L. The two-electrode tube—which may be an ordinary vacuum tube with the plate and grid joined as one electrode, and the hot filament as another—rectifies the current as it passes through the inductance coil L. In L therefore will be found a circuit very rich in harmonics. The vacuum tube used for oscillations should be a power tube such as the U V-202 and a high plate potential (200-300V) should be employed so as to insure a large amount of available energy. We now have ready, by means of this circuit, a source of oscillating current rich in higher frequencies. It is possible to detect them down to the seventh and eighth harmonic. The detection is quite simple. All that is necessary is a receiving circuit containing a microammeter in the detector circuit, as illustrated by figure 6. If instead of a direct source of plate potential for the oscillator we should use alternating current, then it would not be necessary to use a microammeter, but the A.C. hum could be heard directly in the earphones.

We now proceed with our method of calibration. Suppose we set the oscillator so the fundamental oscillation is a known wavelength. Then the harmonics also are known because they are exact halves, thirds, quarters, etc., of the fundamental for the first, second, third, etc., harmonics respectively. To illustrate, if the fundamental be 16900—that of the big naval station at Annapolis—then the first harmonic is 8450, the second is 5633, the third is 4225, the fourth is 3380. In the absence of a standard wavemeter we should, of course, be just as much at a loss to establish our fundamental as we should be in trying to calibrate according to the methods previously outlined. There is a way, however, whereby we can fix a reference circuit accurately at certain high wavelengths, namely, the wavelengths of the high power stations of which Annapolis is an example. The fixing of the reference circuit is done by means of the click method. We listen in for Annapolis using a single circuit oscillating tube receiver (figure 7). Then we tune until the whistle is just reduced to zero frequency: *i. e.,* until as we change the condenser either way, we get the familiar swish of a heterodyne due to a rise in beat frequency. This is the so-called zero heterodyne. With the receiver fixed at this point we couple to it our reference circuit and vary the latter until a click is heard, as before, making our

(*Turn to page* 75)





Put Your Photo in One of These Frames

And Win a Prize in the Subscription Contest

IN the June issue of THE WIRELESS AGE I told about the struggle I have had as a youngster in securing an adequate radio set. As very little was then known about radio, and few dealers even had so much as a glimmering of what it was all about, I had to get my information from library books and carry newspapers in order to purchase the necessary parts.

My first set was a disappointment. It was a good set, but I had worked so hard to get it the result seemed to fall much below my anticipation. I wanted more parts. I wanted a better radio station.

After my set had been completed, and used for some time, my ambition turned to vacuum tube detectors and still better parts. In those days, the old William B. Duck catalogue was my favorite book. I got real joy out of every improvement made.

Once I had conquered the difficulties, I resolved that some day I would make it easy for other young chaps to get the parts with which to build a set. That unquenchable, and very real, desire has stayed with me to this day. My interest has always been centered in boys. In fact, my own boyhood days were a curious admixture of unending troubles. If I wasn't doing a Marathon down the hall with an irate school teacher after me, I was usually misjudging my schoolmates and starting something I could not finish. Often enough I was the despair of my patient parents.

Happily, though, I am now able to realize my ambition—I have the authority and the resources to place within the reach of every live youngster the parts for a radio set, or a complete set ready for operation.

Just write a letter to the BOYS' EDITOR. Tell me whether you want a complete set; parts to go with a set you now have; or just what you do want. I will see that you get it.

First Prize—Paragon RB2 $135.00 Receiver.
Second Prize—Thompson Magnaphone $35.00 Loud Speaker.
Third Prize—N&K Imported $8.50 Headset.

The contest closes September 15th. All subscriptions for the contest must be in this office not later than that date.

The rules of the contest will be found on this page.

In the event of ties, each tying contestant will be awarded a prize identical in character with that tied for.

This contest is open to all who wish to earn their own radio sets.

I have 35,000 names of people who have bought radio sets. Each one of the 35,000 will like to know more about THE WIRELESS AGE. Some of those people, in fact, have been taking the magazine, but forgot to renew their subscriptions. Those 35,000 people live in every part of the country. Some of them live in your own town or city.

When I have received your letter telling me what you want in radio, I will write to you and tell you how many subscriptions you must get in order to earn what you want. Even ONE subscription will get you a radio part.

I will teach you how to sell subscriptions. That is important. I will then give you a calling list, supply you with samples and send you out as a full-fledged salesman. You must be a good salesman, and well trained, before we can put the magazine in your hands as a responsible staff-representative in your district.

When I know that you have the right stuff in you, I will give you the appointment for your section and then establish a credit account in your name. You can draw cash from that account or get what you want in radio parts at wholesale prices.

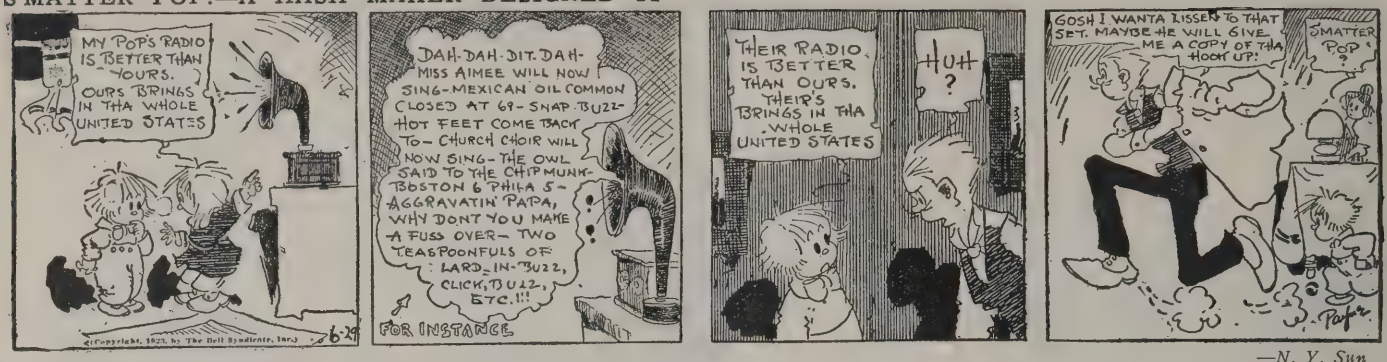
This is not a temporary affair. The job is open to you as long as you feel that I am giving you the proper attention and a good clean-cut proposition.

A surprising development in the widespread response to this offer has forced me to extend the scope of my plans. Some of the old-timers, the successful subscription salesmen, have written to me. Most of them have been selling subscriptions for other national magazines, but have been attracted by this new schedule. The old-timers are experienced and it is exceedingly gratifying to know that they are more satisfied with my plan than any other they had yet had. But to those, and the many other grown-up "boys," who wish to join the ranks, I must definitely state that this schedule will not

(*Turn to page 92*)

LAUGHS in RADIO

S'MATTER POP?—A HASH MAKER DESIGNED IT


MY POP'S RADIO IS BETTER THAN YOURS. OURS BRINGS IN THA WHOLE UNITED STATES
DAH-DAH-DIT-DAH-MISS AIMEE WILL NOW SING-MEXICAN OIL COMMON CLOSED AT 69-SNAP-BUZZ-HOT FEET COME BACK TO-CHURCH CHOIR WILL NOW SING-THE OWL SAID TO THE CHIPMUNK-BOSTON 6 PHILA 5-AGGRAVATIN PAPA, WHY DONT YOU MAKE A FUSS OVER-TWO TEASPOONFULS OF LARD-IN-BUZZ, CLICK, BUZZ, ETC.!!! FOR INSTANCE
THEIR RADIO IS BETTER THAN OURS. THEIR'S BRINGS IN THA WHOLE UNITED STATES
Huh ?
GOSH I WANTA LISSEN TO THAT SET. MAYBE HE WILL GIVE ME A COPY OF THA HOOK UP!
'SMATTER POP ?
Copyright, 1923, by The Bell Syndicate, Inc.

—*N. Y. Sun*

W.J.Y shenectoday
General store
new yorke
states
sir
i am gide for hunter man wot come at dis place lac-des ilse for hunting deer dese hunter man bring it wit him machine for heer you spik from far place i lissen wit him sunday nite also tuseday nite i heer song bout my ole modder dats long town i dont see my modder an i ting dats dame fine song also i heer oder song i dont no de nam tuseday nite storie for de small boy and girl bout make de stars shine for dem of dey is good boy and gil hunter man loff lak dell an tole me ax your how we make some moon shine i heer you spik jus de same lak your at me place i ting you have good machine i lissen more otey wish
tank you and much altigl
Gitz Camille Bruneau
Chein P.O. Quebec Canada

PROF. FOREST C. ENSIGN of the University of Iowa was able to cash a personal check in a strange bank in another city recently with the sound of his voice over the radio as his only identification. An officer of the bank recognized Professor Ensign's voice as one he had heard a short time ago giving an address from the University of Iowa radio station WHAA.

And that—as so many eminent philosophers have remarked—is that. It would be, in our opinion, a real test, if Professor Ensign had cashed a money order at a post office with radio identification.

THE ONLY WAY WE CAN REPAY THEM

Sometime we've just got to make a home grown radio outfit of our own
GR-G-R-R-R-R-R-R-R-R
OO!
O-O-OW-
SQUAWK
NOW LAST NIGHT YOU COULD HEAR EVERYTHING "JUST AS CLEAR!"
SCREECH
SQUAWK
And invite in all our radio-fiend friends who have helped us while away so many evenings

—*N. Y. Tribune*

"The Liar"

A fool there was and he spent his dough
(Even as you and I).
For one of these new fangled radio
That was built for a hundred miles or so
But the fool thought he ought to get Tokio
(Even as you and I).

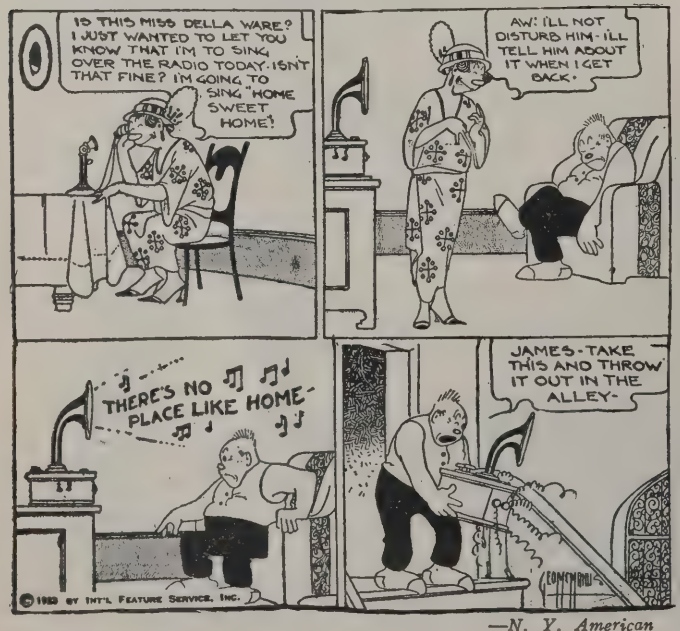
Oh the money it cost
And the sleep he lost
And the wonderful lies he planned
To tell to the fellows who hadn't got wise
And unless they're bugs they'll never get wise
And never will understand.

So the fool stayed up all night and tried
(Even as you and I).
To get the stations away outside
His natural zone just to swell his pride
When he said he got them we knew he lied
(Even as you and I).

Oh the stations he got
And the ones he sought
Are always one and the same
To the radio bug who has learned how to lie
And we all know how easy one lies
If he's in the radio game.

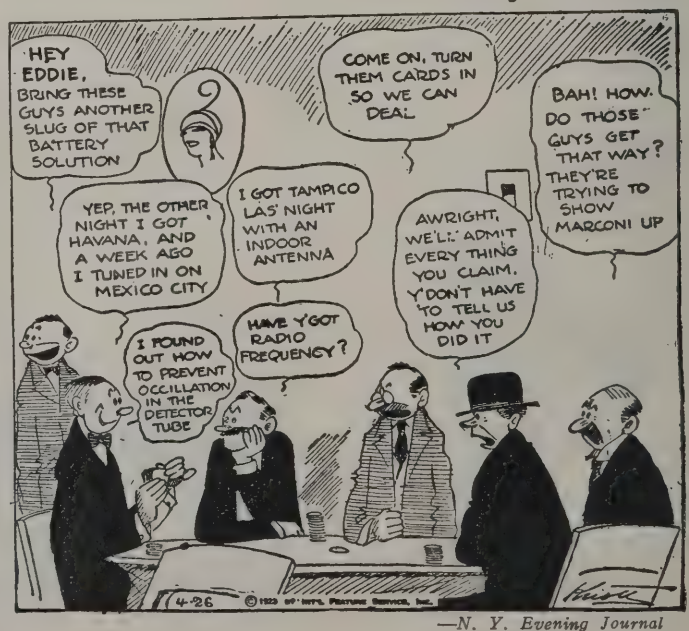
—S. W. Leaver.

BRINGING UP FATHER BY GEORGE McMANUS


IS THIS MISS DELLA WARE? I JUST WANTED TO LET YOU KNOW THAT I'M TO SING OVER THE RADIO TODAY. ISN'T THAT FINE? I'M GOING TO SING "HOME SWEET HOME!
AW! I'LL NOT DISTURB HIM-I'LL TELL HIM ABOUT IT WHEN I GET BACK.
THERE'S NO PLACE LIKE HOME
JAMES-TAKE THIS AND THROW IT OUT IN THE ALLEY-
© 1923 BY INT'L FEATURE SERVICE, INC.

—*N. Y. American*

EDDIE'S FRIENDS BY JEAN KNOTT


HEY EDDIE, BRING THESE GUYS ANOTHER SLUG OF THAT BATTERY SOLUTION
COME ON, TURN THEM CARDS IN SO WE CAN DEAL
BAH! HOW DO THOSE GUYS GET THAT WAY? THEY'RE TRYING TO SHOW MARCONI UP
YEP, THE OTHER NIGHT I GOT HAVANA, AND A WEEK AGO I TUNED IN ON MEXICO CITY
I GOT TAMPICO LAS' NIGHT WITH AN INDOOR ANTENNA
AWRIGHT, WE'LL ADMIT EVERY THING YOU CLAIM. Y'DON'T HAVE TO TELL US HOW YOU DID IT
I FOUND OUT HOW TO PREVENT OCCILLATION IN THE DETECTOR TUBE
HAVE Y'GOT RADIO FREQUENCY?
4-26
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—*N. Y. Evening Journal*

The ABC of Your "C," "B" and "A" Batteries

How to Recharge Your "A" and "B" Storage Batteries From a 32-Volt System and the Correct Method of Tapping "C" Batteries

ALL types of storage A and B batteries may be readily and successfully recharged from a 32-volt farm lighting system. The diagrams show how the Willard A and B radio batteries may be recharged by merely using the house lighting receptacles connecting with a cord and 32-volt lamp in series with the battery.

Select the socket which is most convenient for charging the battery. Screw in an attachment plug, being careful that the two wires do not touch each other. Determine the polarity of the charging wires by placing the ends of the attachment leads in a glass of water. Bubbles will form around the negative wire. If both leads show bubbles, the negative lead will give off a far greater number. After determining which is the positive and which is the negative lead, put some kind of a distinguishing mark on the negative and always use this particular socket when charging.

To properly recharge the batteries the positive of the charging line must go to the positive of the battery. It is possible to recharge only 24 volts of B battery at one time. Therefore, we would recommend the buying of 24-volt B batteries where the charging device is that of a 32-volt house lighting system. Figure 2 shows the manner in which a 48-volt B battery may be recharged, that is by charging only half or 12 cells at one time, then shifting the leads to the additional 12 cells or 24 volts.

It is possible to recharge higher voltages from a 32-volt lighting system; that is, batteries using up to 500 volts on power amplifiers and transmitters, by following the method in the diagram. Any multiple of this system may be used such as 48, 72, 96, and 120 volts.

A fully charged radio A or B battery will have a specific gravity reading of 1.275 to 1.300 and may be considered discharged when it has a specific gravity reading of 1.175. For best radio results the battery should be recharged when it has a reading of 1.200.

Owing to the very low charging current needed for a B battery the efficiency of a charging plant is not lowered to any great extent by charging it from the plant storage batteries, rather than from the generator. However, a high charging current is needed for an A battery and it should only be charged while the generator is being operated to charge the plant battery. After obtaining the polarity make sure that the positive of the charging line is attached to the positive of the six-volt storage battery as indicated in figure 3.

A number of radio set owners today require the use of a C battery. Those who possess Willard storage B batteries need not purchase a separate cell or battery for this purpose.

Figure 1 is a diagram showing the manner in which negative B taps can be taken off the storage B battery and used for C battery purposes.

The voltage for C batteries varies from two to six volts on the ordinary receiving set. If six volts are required, it is necessary to use three storage cells of the B battery, if four volts then two cells, two volts then one cell.

Figure 1 will answer the purpose for most cases. Note that the three end cells of the battery have been divided from the balance of the 24 cells. This hook-up gives an individual six-volt, four-volt or two-volt battery as a C battery. In rare cases it may be that more than six volts will be required for C battery. If, however, more than six

(*Turn to page* 84)

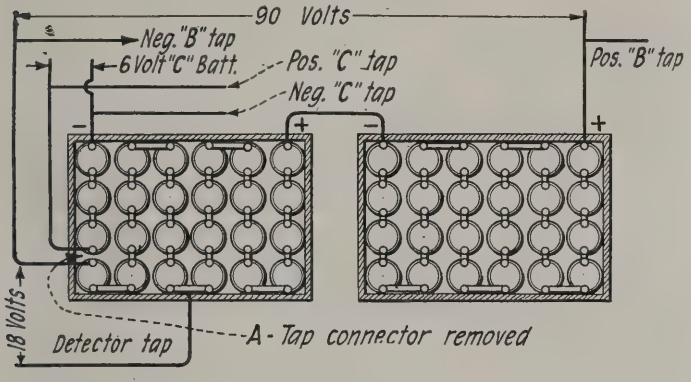


Figure 1

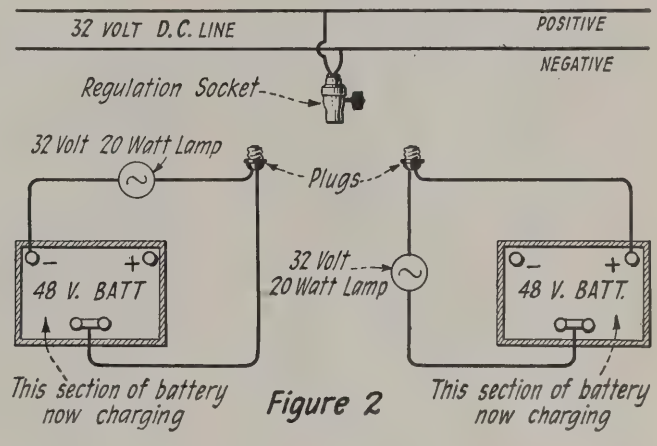


Figure 2

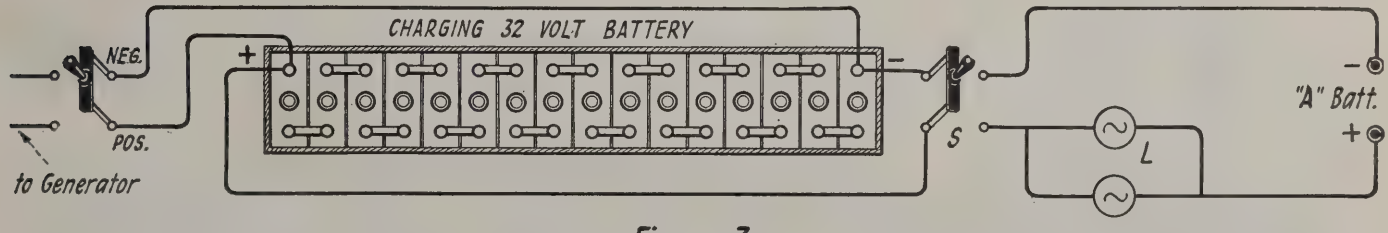


Figure 3

Figure 1—Diagram showing how "C" battery voltage is tapped from regular "B" battery. On receiving sets which connect negative B to negative A it is not necessary to open tap connector A

Figure 2—Charging 48-volt "B" battery from 32-volt D.C. supply

Figure 3—Charging "A" battery from 32-volt system

RADIOVIEWING THE INDUSTRY

The Mart—a Dead Spot—the Southwest—Merchandising—Photography vs. Radio—Literature—the Black Suitcase—and Milwaukee's Radio Exposition

PERMANENT radio expositions in the country's market centers are mute evidence of the growth of radio. More important, these expositions, being of a permanent character, establish radio as an industry that has come to stay.

The Chicago Radio Mart, on Michigan Boulevard, has been opened as a centralized, open-all-the-year-'round exhibition for dealers and jobbers. This represents a worthy confidence in an industry comparatively new. It also indicates an earnest effort to catch-up and run abreast of radio's rapid progress.

* * *

IT has just been learned that DX reception has been logged from a number of distant stations by an antennaless receiving set operated on Montauk Point, L. I., until now believed by the government, many radio engineers and amateurs to have been a dead spot for other than nearby local stations. This performance resulted from a hasty experiment conducted under the supervision of Dr. Francis LeRoy Satterlee, of Flushing, L. I., inventor of the Satterlee Coils, and adds another to a growing list of achievements credited to the inventions of this well-known radio scientist.

At its eastern end, Long Island branches into two arms, and Montauk Point, whose lighthouse is first glimpsed by homecoming Americans, is located on the extreme narrow strip of land, between Block Island Sound and the Atlantic Ocean, as being quite dead for western sending stations. So far as known, previous scientific investigations for radio reception have been discouragingly futile, and it is generally reported that perhaps one of the most remarkable facts concerning the Montauk reception was that all stations were received with no antenna. The receiver itself, which is more commonly known as the Moon C-2-A, manufactured by the Moon Radio Corporation of Long Island City, N. Y., employed by Dr. Satterlee, was taken from factory stock. Dr. Satterlee's official log of the event has recorded the instrument as "Moon C-2-A, No. 1121, stock." Another unusual consideration is that all the stations logged were received with distinct audition over a non-power loud speaker.

* * *

THE Southwest Radio Exposition will be held in Dallas, Texas, November 14th to 22nd, inclusive, in the southwest's finest and largest palace, the Gardner Park Auditorium. This exposition will be under the auspices of the S. W. R. C.

Manufacturers and dealers from all over the country will be there with exhibits. Viewing the situation from the standpoint of local enthusiasm, this show will undoubtedly be a mile-stone in the enterprise of southwestern radio development.

Texas is a large state, geographically. Projects instigated there usually reflect the largeness of its wind-swept plains. Radio is a decided asset to those who live on ranches far removed from human contact of any sort, and Texas intends to make the most of radio.

* * *

ANOTHER instance of progressive merchandising employed in marketing radio products is the attractive display containers in which the sockets, made by the Alden Manufacturing Company, are neatly arranged for the retail trade. Sound merchandising is a guarantee of dependability. The public, just now, is very much interested in that phase of radio.

A new circuit booklet entitled, "What to Build" is printed by this concern, and packed with every Na-ald product. This booklet shows diagrams, and includes complete building information for several selected and tested circuits using from one to five tubes. Among these circuits are the Neutrodyne, Reflex Superdyne, and a Two-Stage Amplifier. Other information of interest to the radio owner is contained in this booklet. It may be purchased direct by those who care to send for it.

* * *

CLARENCE E. OGDEN, Founder and President of the Automatic Electrical Devices Company, manufacturer of the Homcharger, has recently organized and incorporated under the Laws of Ohio, a new concern—The Kodel Manufacturing Company—for the manufacture of a portable radio set, of which he is the inventor.

This company's first offering to the trade will be a small, compact and really portable long distance radio set—The Kodel—the Camera of Radio. This set weighs less than five pounds complete with all accessories. Contained within a neat leather covered case is a standard UV-199 tube, "A" and "B" dry batteries, pair of standard head phones, ground and aerial wires.

Tendency toward compactness in radio outfits will probably do for radio what the small folding camera did for amateur photography.

Radio leaders who attended the Associated Manufacturers of Electrical Supplies at Atlantic City to discuss super broadcasting. Insert: Pierre Boucheron, Chairman of Publicity Committee. Rear (left to right) L. S. Brach of Newark, E. T. Edwards, General Electric Company, Schenectady, E. Mallory, Westinghouse Electric and Manufacturing Company, New York, A. J. Carter, Chicago, E. E. Bucher, Radio Corporation of America, New York, M. C. Rypinski, C. Brandes, Inc., New York, G. Stein, General Electric Company, Schenectady. Front (left to right) G. V. Howard, Dubilier, New York, G. C. Furness, National Carbon Company, New York, I. Adams, Radio Corporation of America, N. Y., G. K. Heyer, Western Electric Company, N. Y., R. H. Manson, Stromberg Carlson, Rochester

LITERATURE invariably follows in the wake of any activity. Much of it is useless. That which actually contains information of value to those who are interested in the particular activity seldom realizes the proper distribution. Book reviews, in daily and periodical publications, serve that end in good measure, but only for literature of a non-publicity character.

Many radio manufacturers have printed booklets, designed, of course, to promote their individual interests, but commendable on the very good grounds of dispensing knowledge.

A striking example of this is to be found in booklets published, from time to time, by the Federal Telephone and Telegraph Company. Their latest achievement is offered in, "Who Will Be the Next President"?

* * *

THE DX Instrument Company have printed a small booklet, "Improved Radio Reception Through Scientific Tube Tuning," in which the vacuum tube has been comprehensively explained. The necessity of tuning the vacuum tube, perfect adjustment, the problem of the tube control, and just what happens in a tube, has all been dealt with in a manner worthy of the reputation enjoyed by text books.

"Amplification Without Distortion," is a fifth edition of that booklet, published by the Acme Apparatus Company. It contains 36 pages of information that every set owner would find of real value, exceptionally well illustrated, and surprisingly to the point. In general, it is a discussion on radio, with particular reference to the construction and operation of radio, audio and reflex amplifiers and sets. Space alone prohibits the review which this thorough-going booklet deserves. Incidently, it will be well to ask for the supplementary pamphlets when writing for this booklet.

Lewis J. Selznick has entered the radio field with the same enterprise that has made for his remarkable success in moving pictures. He has issued a leaflet presenting "The Miraculous Voice From the Sky" in which he incorporates his new Portable Voceleste Receiver. The unsuspecting reader would anticipate another story of a "just released film." Mr. Selznick then followed with a clever booklet entitled, "Getting Results with the Voceleste" (Voice from the Sky). This is arranged in a clear, concise manner that makes it interesting reading whether one has a Voceleste or not.

* * *

THE Zenith Radio Corporation has a new six-tube portable set, including batteries and loud speaker, built into a small suitcase.

President McDonald of the Zenith Radio Corporation made a remarkable demonstration in Chicago. Carrying the set, he started from the twentieth floor of the McCormick Building, rode down the elevator, walked through the lobby, stepped into a taxi, and traveled around the city, a tenor singing apparently from the suitcase during his sojourn. This continued on his way into the Congress Hotel. Throughout the demonstration, crowds gathered, hardly believing their hearing. When Mr. McDonald repeated this experiment in New York, a near riot occurred.

The dramatic character of such episodes is a passing incident. Of far greater importance is the significance of such possibilities. Compact, portable receivers will probably add tremendous impetus to the spreading of the gospel of radio.

The R.C.A. Distributors' Service Class

* * *

THE first session of the "Distributors' Service Class" was held at 98 Worth Street in the Technical Class Room of the Radio Institute. Forty-one were present, representing a large number of RCA distributors in the Eastern District. The class was called to order and its object briefly explained. Mr. Chubb and Mr. Holmes, of the Westinghouse Electric and Manufacturing Company, were then introduced, their subject being Radiola III, Radiola III-A and Radiola Balanced Amplifier. After the talk all questions were answered and instruction was given on locating and remedying defects.

The next program was discussion on Radiola Regenoflex and Radiola X. Immediately following this, luncheon was served at the Pine Tree Restaurant; followed by inspection of the Harrison Lamp Works.

The following is a complete list of those attending the first session: Aeolian Company, J. A. Wotten, W. H. Converse, Jr., New York City; Beckley-Ralston Co., H. Marshall, Pittsburgh, Pa.; Charleston Elec. Sup. Co., E. H. Robertson, Jr., West Virginia; Doubleday-Hill Elec. Co., A. J. Zugel, Washington, D. C.; Elliott-Lewis Elec. Co., G. E. Sammens, Philadelphia; F. D. Pitts Co., R. Lennihan, Boston, Mass.; F. H. Stewart Elec. Co., D. C. Cook, Philadelphia; H. C. Roberts Elec. Co., C. F. Phillips, Syracuse, N. Y.; Havens Elec. Co., Inc., S. J. Lane, Albany, N. Y; Iron City Elec. Co., J. E. Tarter, E. J. Handlon, W. D. Lowery, Pittsburgh, Pa.; Landay Brothers, E. J. Clarke, New York City; Lewis Elec. Sup. Co., W. J. Downey, Boston, Mass.; Ludwig Hommel & Co.; J. H. Hall, W. K. Thomas, Pittsburgh, Pa.; Manhattan Elec. Sup. Co., Inc., W. E. Moran, New York City; McCarthy Bros. & Ford, J. Eichman, Jr., Buffalo, N. Y.; Music Master Corp., J. H. Peth, Pittsburgh, Pa.; National Light & Elec. Co., J. S. Gelon, Newark, N. J.; National Elec. Sup. Co., W. J. Selt, E. L. Maschmeyer, Washington, D. C.; Penn Elec. Eng. Co., W. E. Acker, Scranton, Pa.; Pettingell-Andrews & Co., C. M. Bishop, Boston, Mass.; Pierce Elec. Co., J. A. Mook, Jr., Tampa, Fla.; Radio Dis. Co., A. Nelson, Newark, N. J.; Robertson Cataract Elec. Co., H. R. Lord, Buffalo, N. Y.; Robertson Cataract Elec. Co., C. N. Van Cleef, Rochester, N. Y.; Southern Electric Co., L. W. Passano, Baltimore, Md.; Superior Supply Co., E. K. Kitts, Bluefield, W. Va.; Stoehr & Fister, R. Besecker, Scranton, Pa.; Times Appliance Co., R. E. Cook, New York City; Tri-City Elec. Co., F. E. Leach, Newark, N. J.; Union Elec. Co., A. E. Baumbach, Pittsburgh, Pa.; Union Elec. Sup. Co., R. J. Liedel, Providence, R. I.; Wetmore Savage Co., H. Finn., Boston, Mass.; Woodhouse Elec. Co., J. F. Gulley, B. Goodman, Norfolk, Va.; Jos. M. Zamoiski Co., J. Holloway, Baltimore, Md.

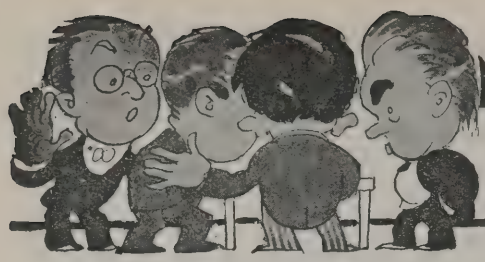
BELIEVING that the fall and winter seasons promise to show the greatest development in the popularity of radio in Milwaukee, nearly one hundred dealers have joined forces for a radio exposition. The co-operative demonstration will be held September 1 to 7 at one of the largest halls in the downtown section of Milwaukee. Each firm participating will have demonstration space in which to show their equipment. The show will be under the direction of the *Milwaukee Journal.*

Dealers in Milwaukee became interested in the radio possibilities of a united exposition after the *Milwaukee Journal* had completed a survey of the city showing that but one family out of every ten owned radio equipment.

The exposition will be held in the Arcadia Ballroom of the Hotel Antlers, in the heart of Milwaukee's downtown business and theater section. The program will include artists from the larger broadcasting stations who have been heard in Milwaukee in the last year. This includes the larger stations in Chicago, Elgin, Ill., Davenport, Ia., and others. Each night during the exposition a different set of entertainers will do actual broadcasting from the exposition auditorium. Arrangements have already been made for the appearance of these popular artists.

The demonstration will be held the week following the Wisconsin State Fair at Milwaukee. An attendance of more than 50,000 is predicted. One-third of the total spaces have already been allotted to Milwaukee dealers.

Local radio dealers have expressed the opinion that what radio business needs more than anything else is a chance to educate the public on radio development and that every effort made to bring the dealers and public nearer together merits their support.

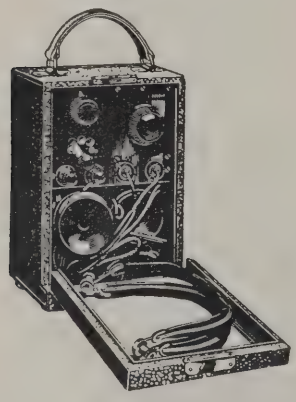


NEW APPLIANCES AND DEVICES

Allen Soldering Paste

L. B. ALLEN CO., INC., manufacturers of soldering supplies, located at 4519-29 N. Lincoln St., Chicago, Ill., recently developed a new soldering paste known as the Allen Special Radio Soldering Paste. This paste is guaranteed by the manufacturers to be non-corrosive, fumeless and is approved by the National Board of Underwriters. It is a quick working flux designed to secure a clean soldered job. It is put up in a conveniently sized can and retails at a low price. In connection with this new soldering paste the company has published an interesting pamphlet "How and Why to Solder Radio Sets."

Kodel Portable Receiver



WITH reams being written every day and the radio magazines devoting some of their space to the portable radio receiver, the Kodel Manufacturing Company of Cincinnati, Ohio, deems the time propitious to announce the Kodel. This is a complete radio receiver packed in a camera case. Complete is really the word to use as space has been provided for "A" and "B" battery, vacuum tube and head phones, together with two collecting wires; and weighing as a whole only 4¾ pounds.

No aerial is necessary, and by attaching the ground to a water pipe or some other connection that will complete the circuit, the receiver is ready for use.

Sales to the vacationists are being pushed as the Kodel Company sees tremendous possibilities in this field: Long range, easy carriage and low price being the big factors in the appeal. This receiver has an appeal to all classes of vacationists as it is adaptable to various conditions and will meet with the most exacting requirements.

Prest-O-Lite Co. Broadcast Auto Race

MOST of the thirteen and one-half million automobile owners are interested in the International 500-Mile Race at Indianapolis, yet only about one hundred and fifty thousand of them get an opportunity to see this speed classic. But this year The Prest-O-Lite Co., Inc., of Indianapolis, whose enormous factory is directly across the road from the Speedway, broadcast the race through Chicago Tribune Station, WGN, and the speed fans got a realistic impression of the race on their radio.

A special wire was run from a soundproof booth in front of the judges' stand at the Speedway direct to the broadcasting station at Chicago and over this wire one of the most absorbing pictures of a sporting event ever given went on the air.

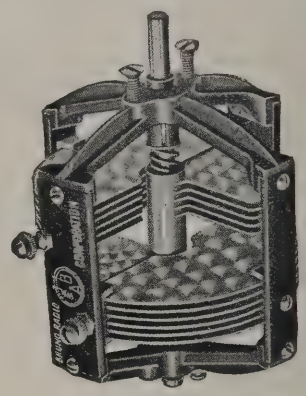
Special arrangements were made to cover every phase of the activity at the huge 2½ mile brick oval. Leading to the booth were telephone lines from important points at the track. For instance technical experts stationed at the pits furnished authoritative information on the pit stops of the cars. The reporting of the standing and the speeds of the cars alone presented a problem requiring quick, accurate co-operation as the race proved to be the fastest and most bitterly fought in the history of the classic with the lead frequently alternating.

From the standpoint of realism, the broadcasting has seldom been excelled. The roar of the motors, the cheering of the crowds, the tense instructions of the drivers as they stopped for supplies and hasty adjustments were so graphically transmitted from a special microphone in the Prest-O-Lite pit that listeners said, "Everything was there except the smell of burning rubber."

"Sen" Kaney, one of the best known of his craft, handled the announcing. Henry Ford supplied an unexpected feature of the day's activities by addressing the radio fans on the significance of the race in relation to the automobile industry. Mr. Ford, who himself was a builder and pilot of racing cars in the early days of his career was referee of the race.

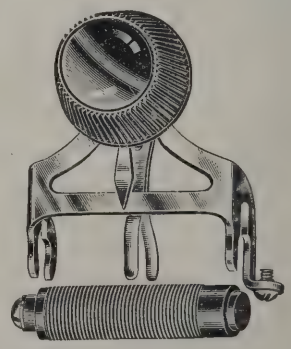
It is reported that the broadcasting aroused unusual interest. Hundreds of thousands of sets tuned in and in radio stores, garages and private homes great crowds followed the progress of the race on special charts which were distributed by The Prest-O-Lite Co. Thousands of telegrams, letters and applause cards were received thanking The Prest-O-Lite Co. and the Chicago Tribune for the wonderful program and congratulating them on their success.

The Multiple Tuning Bruno Condenser



THE Bruno Radio Corporation, 300 Water Street, N. Y. City, announce that they are now in production on a new low loss condenser. There are many features embodied in this precision instrument. Long brass bearings insure smooth turning and long life. The method of mounting this condenser is greatly simplified by the three-in-a-line arrangement for drilling. The 22-plate type Bruno Ultra-Vario Condenser as pictured here has two 11-plate blocks which are electrically insulated from each other. Consequently by parallel or series connections a user may obtain a 7, two 11's or a 22-plate condenser. This model has been so designed by Bruno engineers to be used to tune two stages of radio frequency with one dial. This feature alone should appeal to the amateur who wishes to simplify the number of tuning controls. The price is $5.50 list.

Unity Cartridge Rheostat



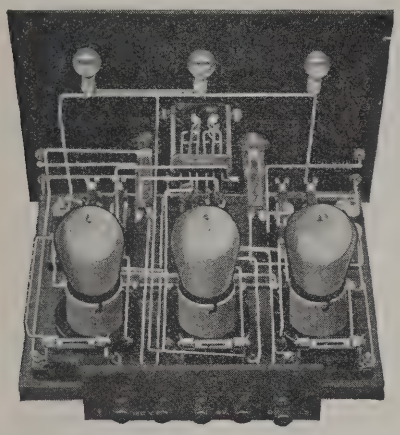
THE Unity non-vernier rheostat, or cartridge rheostat, is designed for efficiency and economy, say the makers, the Unity Manufacturing Co., Chicago. A phosphor bronze fork type of contact is used. This insures minimum changes and smooth variations in resistance. The positive contact given by the fork type makes certain that no distortion or noise is caused by leaks in the amplification circuit, where non-vernier rheostats are used.

The rheostat is single hole mounting. Resistance cartridges suitable for each tube are sold separately, so that tubes may easily be changed in a set, and the proper resistance inserted, without removing the bracket from the panel, and at very small expense. Potentiometer Cartridges are also made which fit the same brackets.

Daven Resistance-Coupled Amplifier

THE Daven Radio Company have brought out the type 3-A Amplifier illustrated, and in their catalogue set forth its merits very enthusiastically.

It is claimed that this amplifier is worth while to the broadcast enthusiast because of the absence of distortion in receiving programs.

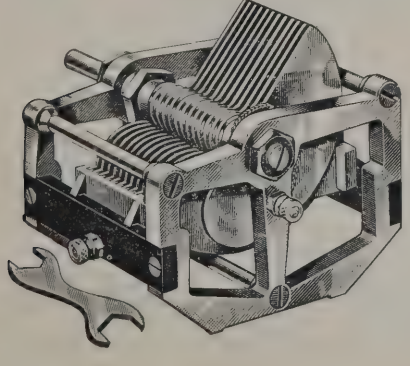


It is said that in addition to other features this amplifier consumes ¼ of the usual plate current and eliminates the necessity of using "C" batteries. Another advantage is that there are no delicate windings or wires to fuse under the strain of excessive loads. The ballast resistors eliminate the necessity of rheostats to maintain a proper filament current throughout the useful discharge of the "A" battery. The Amplifier is equipped with pilot lamps showing what tubes are in operation. The wiring system is so arranged that the plugging in of the receivers automatically cuts out the Loud Speaker attached to the binding posts.

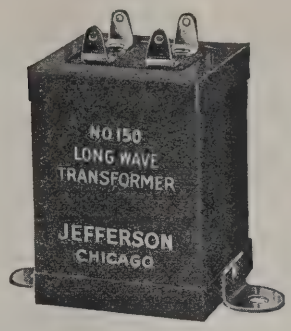
Bremer-Tully Condenser

A NEW "laboratory type" variable condenser is among the latest products of the Bremer-Tully Mfg. Co.

This is of the "low-loss" "high-ratio" type. It is arranged for either panel or baseboard mounting and both rotor and stator plates of aluminum are cast by a new and improved method. End plates are, also, of cast aluminum of unique design, which gives the product a very handsome appearance.



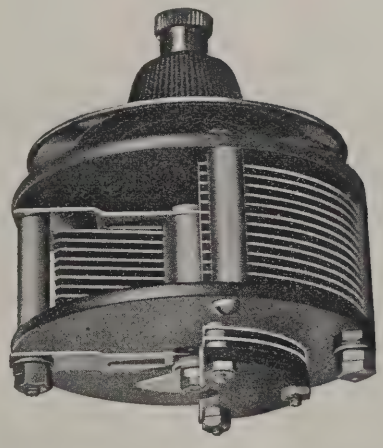
Long Wave Transformers



JEFFERSON ELECTRIC MFG. COMPANY'S Intermediate Frequency Transformers are especially designed for use as amplifiers in all circuits requiring this type transformer. In such circuits it is highly important that the transformers match and are in perfect balance. A slight deviation will usually render the set inoperative. Expert designing and workmanship have placed behind these transformers the reputation for uniformity of manufacture and performance which all Jefferson products enjoy. Their specially constructed, high grade laminated silicon steel cores assure great stability and power. This transformer covers a range of wave lengths from 5,000 to 25,000 meters.

Newest Type of Rathbun Condenser

THE newest member of the Rathbun family is a vernier combination type with main rotor shaft and vernier rotor shaft absolutely independent of each other; it is



impossible for one to move the other under any condition of adjustment. The new condenser has a positive and independent contact for both vernier and main rotor; no current passes through bearings. These points and the fact that all metal parts are of brass, bronze and aluminum insure minimum resistance. High efficiency and low loss are secured through wide spacing of contacts from rotor and stator element and the use of the minimum amount (consistent with strength) of the best grade of bakelite obtainable as dielectric for end plates. A vernier capacity of .00002 mfd. affords a real vernier adjustment that makes tuning of the most critical circuit an easy matter.

N&K Imported Loudspeaker

THE N&K Imported Loudspeaker, Type W, has broken away from all tradition.

It projects sound by reflection. In this process the sound in diffused so that it issues from the speaker in all directions, not merely in one direct line. It projects sound waves in their full roundness, giving forth a soft, mellow, musical tone.

It is different in shape. The N&K Imported Loudspeaker is not easily tipped over or knocked down. Circular in shape and mounted on a low flat base, it presents an agreeable appearance to the eye and harmonizes with the furnishings of even the finest home. It is economical of space. The pleasing black and gold stippled surface

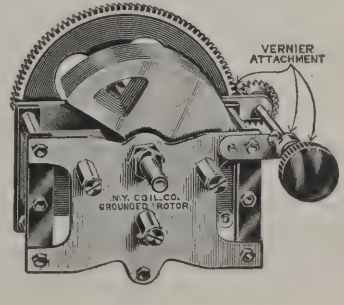
gives it an air of distinction also. The base, felt protected, does not scratch or mar polished surfaces.

Type W, N&K Loudspeaker is made of burtex, a scientific product providing the stiffness of wood or metal, but neither cellular nor crystalline in composition. It is more like a very thick, absolutely rigid fabric. This quality causes it to transmit only the actual vibrations of the broadcast waves.

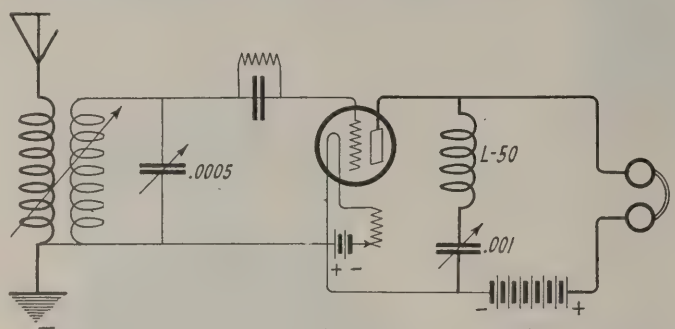
The unit used in the new Type W, N&K Loudspeaker embodies the same quality of tone as the N&K phone units, but is adapted to amplification purposes. It is especially designed for the reproduction of musical tone, bringing out the entire range of the human voice or musical instrument with extreme clearness, sharpness and naturalness.

New York Coil Condenser

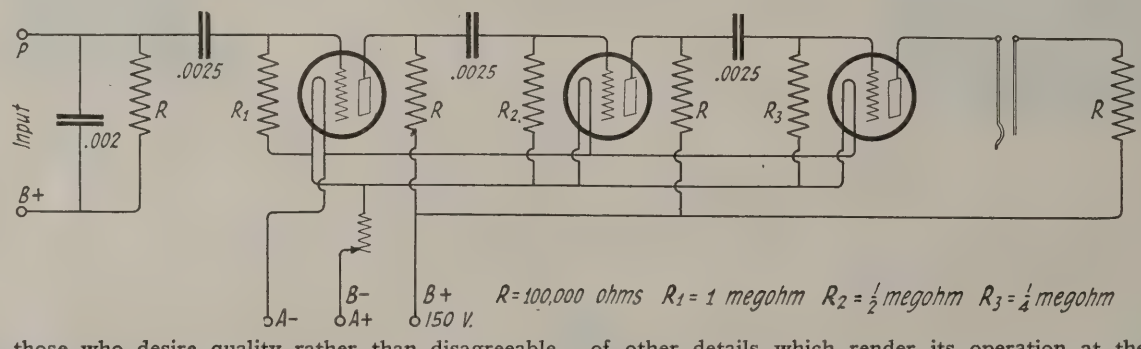
A LOW loss grounded rotor variable condenser of novel design. Adjustable cone bearings support the revolving plates. Flexible pigtail connections prevent loose contacts. Hard rubber is used as the dielectric. A geared vernier may be added by attaching with screws.



Selected Radio Hook-Ups for the Home-Builder



IN figure 1 we show a circuit which few of the present day constructors are familiar with. It is the, at one time, well-known "X" circuit designed by Roy Weagant for the reception of long wavelengths and employing large honeycomb coils. It takes very little twisting and turning of this diagram to show the old Reinartz circuit which suddenly came into such marked popularity at the advent of broadcasting. It is a very simple matter to convert the two honeycomb coils one tube super-regenerative into this circuit. All that is needed to change is the addition of a 43-plate variable condenser and a 50-turn honeycomb coil inserted in the plate circuit as shown. If the circuit does not oscillate readily the coil L should be placed in inductive relation to the secondary coil. This primary-secondary coil can be either a variocoupler or two honeycomb coils. In connecting up the circuit be sure that the rotary plates of the variable condenser are connected to the filament side of the circuit. Any type of tube may be used and the "A" battery and rheostat should conform to the type of tube employed. Do not shunt the phones and "B" battery with a fixed .001 mfd. condenser as in ordinary circuits as this is the equivalent of placing this condenser between the grid and plate terminals of the tube. The path of the radio-frequency current should be from the plate of the tube through the coil L through the variable condenser to the grid circuit by way of the positive filament. In case the circuit does not oscillate insert in the plate circuit between the coil L and the phones a choke which may be a 200-turn honeycomb coil. This will prevent the radio-frequency currents from passing through the phones and high resistive "B" battery. It will be found that this circuit if constructed properly will give a very nice control of regeneration, being a very stable and sensitive receiver.

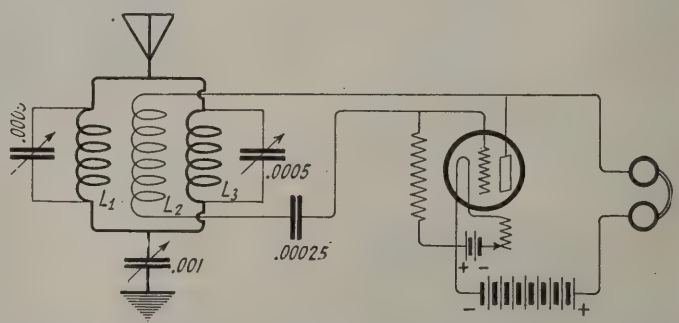


FOR those who desire quality rather than disagreeable volume coming forth from a loud speaker, the resistance coupled amplifier shown in the diagram in figure 2 comes the closest to approaching the ideal. Because of its characteristics it can be used as a radio-frequency amplifier, as an audio-frequency amplifier or as an intermediate frequency amplifier in connection with a heterodyne receiver. When used as an amplifier of radio frequencies it is not recommended for use on the 200- or 600-meter wave band, because of other details which render its operation at these frequencies very poor. The construction of such an amplifier is very simple and has been made more so since the advent on the market of suitable mountings for the resistances and grid leaks and coupling condensers. For further information on these consult the "ads" in the last pages of this issue and the article on the super-tone amplifier. In figure 2 the value of "R" is 100,000 ohms. R-1 is one megohm, R-2 is one-half megohm, R-3 is one-quarter megohm.

FIGURE 3 represents a Colpitts oscillator used in a detector circuit with the addition of a wave trap and an oscillation trap. These latter two items also comprise the antenna tuning circuit. Coil L2 is a 50-turn honeycomb coil which comprises the grid plate circuit. As it stands now this represents an oscillating circuit.

It is a continuous generator of oscillations, the frequency of which is dependent upon coil L2 and the coupling between L1 or L3 and L2.

In order to control this oscillation and permit the right amount of regeneration the trap and tuning circuits L1 and L3 are shown. These are inductively coupled to the coil L2 and this coupling should be variable. Many of us will remember that this is quite the same as the four-circuit tuner except for the antenna coupling. The coil L3 acts as an absorber of oscillations and the condenser across this coil is employed to bring it into resonance with the coil L2. L1 serves as a wave trap and a tuning control for the antenna circuit together with a condenser shunted across it. A vernier rheostat control such as the Filkostat should be used in order to secure the best results. This circuit, like most honeycomb coil circuits, is rather difficult to tune at first and it will be necessary for the operator to acquire a little experience in this type of receiver in order to get the knack of it. In connecting the variable condensers into the circuit, be sure that the rotary plates are hooked up to the ground and the stator plates to the aerial to avoid hand capacity effects in tuning. In case the circuit does not oscillate, insert in the plate circuit between the phones and the plate a radio-frequency choke. This can be made up by winding 250 turns of No. 28 D. S. C. wire on a two-inch tube in a helter-skelter fashion. Don't use regular nor banked nor any fancy winding.



To Those Who Attend Church

(*Continued from page 33*)

Church, offered his morning prayer. Through the courtesy of Dr. Gilkey, the usual church announcements were made over the radio and the offering was taken at the proper time by deacons of the church.

The full service, including hymns, announcements, choir singing and sermon came in with great clarity and the audience was unanimous in endorsing the whole arrangement.

The inspiration for the service came to the pastor one day as he was passing a Springfield music store where a radio receiving set with loop aerial was being exhibited. Entering the store he made arrangements for a preliminary "try-out" of the set at his church. A group of officials who heard the set on the night of the "try-out," were loud in their praise of its performance. In fact, so loudly did the concerts come in from Louisville, Ky., Washington, D. C., and Boston, Mass., that the operator was compelled to soften the tones to a large extent.

On the previous Sunday to the radio service taking place, the pastor made arrangements with the congregation to sing the Doxology at the close of the service and also instructed the deacons to greet the people as they left the auditorium. Previous arrangements were made with Dr. Gilkey to say a few words of greeting to the members of the church.

The introduction of a service of this type into a country church has opened up a great field of speculation. One writer claims that soon funerals, weddings and all church services as well as pastoral visitations will be conducted from a city church sending station by radio. Such a view, however, is not logical to any who understand modern country life where the social factor is to be considered. The country church is always in need of a personal leadership. However, what we do think will come will be the introduction of a radio sending apparatus into the average country parsonage which at stated times can be used by a busy pastor to keep in touch with his members and constituents living at a distance from the center. One thing is sure, that the latest improvements in the scientific world are quite readily introduced into a country church today.

Tempering the Weather

(*Continued from page 61*)

vations serves its purpose admirably and radio will hardly displace the Morse telegraph in this particular service.

A farmer quotes a weather report to the effect: "Farmers be merciful to live stock tonight, a cold wave is coming and the weather will be down below zero before morning, with a piercing cold wind from the North." He obeyed the mandate of the Weather Man and his cattle were snugly enclosed under shelter. The name of this farmer will be legion if we are to accept the seasoned opinion of E. B. Calvert, meteorologist in charge of the Forecast Division of the Weather Bureau, when he told the writer:

"The Weather Bureau has taken advantage of the opportunity that radio telephony provides for reaching the farmers, and arrangements have been made for the establishment of broadcasting systems in all of the states. Government, commercial and private broadcasting stations are utilized. Forecasts and warnings are furnished to these stations and are broadcast on schedule hours two or three times daily.

Methods of Wavemeter Calibration

(*Continued from page 66*)

coupling a minimum. In this way we know that the reference circuit is tuned to the same wavelength as Annapolis, namely 16900 meters. Care should be taken to tune in the fundamental and not a harmonic of this station.

With a reference circuit adjusted to 16900 meters we go back to the source of harmonics and adjust the fundamental to 16900 meters using the reference circuit as wavemeter. Then the first harmonic is 8450, the second 5633, the third 4225, and the fourth 3380. Let it be assumed that our wavelength calibration is to cover a range of 3500 meters down to one hundred meters. The wavemeter being calibrated is adjusted to the fourth harmonic of the source of oscillations by coupling to it—namely to 3380 meters. We can then use this adjustment to set our oscillation source at 3380 meters. This fundamental will have a first harmonic of 1690, a second harmonic of 1126, a third of 845, a fourth of 674, a fifth of 563. The unknown wavemeter is tuned in successively to these harmonics. To get lower down on the curve of calibration we again change our fundamental setting by use of the just obtained calibration points, this time, to 1126. The first harmonic of this fundamental is 563, the second is 378, the third is 281, the fourth is 225, the fifth is 187. By an additional resetting we can reach as far down as desired. To fill in the gaps between calibration points we start another series with a first setting of the fundamental at 4225 instead of 3380. It is obvious that we can find as many points as necessary for a smooth continuous curve by choice of suitable reference wavelengths and harmonics. It is also evident that by merely listening in to one wavelength, namely, 16900, of Annapolis, we can calibrate a wavemeter through any desired range with considerable accuracy. The whole procedure is shown in figure 8.

The method in the description of it seems complicated. But in reality it involves merely the use of some large coils, condensers, a microammeter, besides the more usual possessions of a radio experimenter. It has the advantage of requiring no standards and a use of the method will teach more about the properties of radio circuits than many pages of reading can tell.

Standard Wavelengths Used for Calibration

The next and final method of wavemeter calibration to be discussed, like the previous one, requires no standard meter. It is based on the fact that the Bureau of Standards station WWV, Washington, D. C., sends out periodically a series of standard wavelength signals by continuous wave, preceding the signal by an announcement of the wavelength. The power of the station is sufficient to make it audible anywhere east of the Mississippi. In brief, the method is this: The WWV signals are picked up by a unicircuit oscillating tube receiver. The C.W. is heterodyned and the receiver accurately adjusted to zero heterodyne at each one of the waves broadcast, in every case the condenser setting being noted. Then the wavemeter which is to be calibrated is coupled with the receiver and by the click method already described, at each of the settings of the receiver successively, the wavemeter is adjusted so as to just cut out the oscillations, using loose coupling. Then, as before, the wavemeter setting for each case equals the wavelength of the WWV signal. Thus data is furnished for drawing smooth calibration curves.

The transmissions on August 5 include the frequencies used by ship and point-to-point communication, those on September 5 ship communication, those on September 22 broadcasting.

All transmissions are by unmodulated continuous-wave telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of the eight-minute period and continues for about two minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters WWV intervening. This signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted, and contain a statement of the measured frequency.

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	326
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270
KDPT	Southern Electric Co.....San Diego, Calif.	244
KDYL	Newhouse Hotel.....Salt Lake City, Utah.	360
KDYM	Savoy Theater.....San Diego, Calif.	280
KDYQ	Oregon Institute of Technology, Portland, Ore.	360
KDYX	Star Bulletin.....Honolulu, Hawaii	360
KDZB	Frank E. Siefert.....Bakersfield, Calif.	240
KDZE	Rhodes Co.....Seattle, Wash.	270
KDZI	Electric Supply Co.....Wenatchee, Wash.	360
KDZR	Bellingham Publishing Co., Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co...Phoenix, Ariz.	360
KFAE	State College of Washington....Pullman, Wash.	330
KFAF	Western Radio Corp.....Denver, Colo.	360
KFAJ	University of Colorado.....Boulder, Colo.	360
KFAN	The Electric Shop.....Moscow, Idaho	360
KFAR	Studio Lighting Service Co...Hollywood, Calif.	280
KFAU	Boise High School.....Boise, Idaho	270
KFAW	The Radio Den.....Santa Ana, Calif.	280
KFAY	Virgin's Radio Service.....Medford, Ore.	283
KFBB	F. A. Buttrey & Co.....Havre, Mont.	360
KFBC	W. K. Azvill.....San Diego, Calif.	278
KFBE	Reuben H. Horn.....San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church....Tacoma, Wash.	360
KFBK	Kimball-Upson Co.....Sacramento, Calif.	283
KFBL	Leese Bros.....Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News, Trinidad, Colo.	360
KFBU	The Cathedral.....Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.....Phoenix, Ariz.	238
KFCF	Frank A. Moore.....Walla Walla, Wash.	360
KFCV	Fred Mahaffey, Jr.....Houston, Tex.	360
KFCY	Western Union College.....Le Mars, Iowa	252
KFCZ	Omaha Central High School.....Omaha, Nebr.	258
KFDA	Adler's Music Store.....Baker, Ore.	360
KFCP	Ralph W. Flygare.....Ogden, Utah	360
KFDD	St. Michael's Cathedral.....Boise, Idaho	252
KFDH	University of Arizona.....Tucson, Ariz.	268
KFDJ	Oregon Agricultural College.....Corvallis, Ore.	360
KFDO	H. Everett Cutting.....Boseman, Mont.	248
KFDV	Gilbrecht & Stinson.....Fayetteville, Ark.	360
KFDX	First Baptist Church.....Shreveport, La.	360
KFDY	South Dakota State College..Brookings, S. Dak.	360
KFDZ	Harry Q. Iverson.....Minneapolis, Minn.	231
KFEC	Meier & Frank Co.....Portland, Ore.	248
KFEL	Winner Radio Corporation.....Denver, Colo.	254
KFEQ	J. L. Scroggin.....Oak, Nebr.	360
KFER	Auto Electric Service Co.....Fort Dodge, Iowa	231
KFEV	Felix Thompson Radio Shop.....Casper, Wyo.	263
KFEK	Augsburg Seminary .....Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho	360
KFEZ	Associated Engineering Societies of St. Louis, St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.....Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.....Pendleton, Ore.	360
KFFO	E. H. Smith.....Hillsboro, Ore.	229
KFFQ	Marksheftel Motor Co.....Colorado Spgs. Colo.	286
KFFR	Nevada State Journal.....Sparks, Nev.	226
KFFV	Graceland College .....Lamoni, Iowa	360
KFFX	McGraw Co. .....Omaha, Nebr.	278
KFFY	Pincus & Murphy.....Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.....Dallas, Tex.	226
KFGC	Louisiana State University....Baton Rouge, La.	254
KFGD	Chickasha Radio & Elec. Co., Chickasha, Okla.	248
KFGL	Snell & Irby .....Arlington, Ore.	234
KFGQ	Crary Hardware Co.....Boone, Iowa	226
KFGB	Heidbreder Radio Supply Co.....Utica, Nebr.	224
KFGX	First Presbyterian Church.....Orange, Tex.	250
KFGZ	Emmanuel Missionary Coll..Berrien Spgs., Mich.	286
KFHA	Western State College of Colo., Gunnison, Colo.	252
KFHB	Rialto Theater .....Hood River, Ore.	280
KFHF	Central Christian Church.....Shreveport, La.	266
KFHH	Ambrose A. McCue.....Neah Bay, Wash.	261
KFHJ	Fallon & Co.....Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.....Seattle, Wash.	283
KFHX	Robert W. Nelson.....Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)....Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage.....Iola, Kans.	246
KFIF	Benson Polytechnic Institute.....Portland, Ore.	360
KFIL	Windisch Elec. Farm Equip. Co., Louisburg, Kans.	234
KFIO	North Central High School.....Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association, Yakima, Wash.	242
KFIU	Alaska Elec. Light & Power Co., Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman, Fond-du-Lac, Wis.	273
KFJB	Marshall Electric Co.....Marshalltown, Iowa	248
KFJC	Seattle Post-Intelligencer .....Seattle, Wash.	270
KFJF	National Radio Mfg. Co., Oklahoma City, Okla.	252
KFJI	Liberty Theater .....Astoria, Ore.	252
KFJK	Delano Radio & Electric Co.....Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.....Ottumwa, Iowa	242
KFJM	University of North Dakota, Grand Forks, N. D.	280
KFJQ	Electric Construction Co., Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son....Stevensville, Mont.	258
KFJV	Thomas H. Warren.....Dexter, Iowa	224
KFJX	Iowa State Teachers College, Cedar Falls, Iowa	280
KFJY	Tunwall Radio Co.....Fort Dodge, Iowa	246
KFJZ	Texas Nat'l Guard, 112 Cav., Fort Worth, Tex.	254
KFKA	Colorado State Teachers' Coll....Greeley, Colo.	273
KFKB	Brinkley-Jones Hospital Assn., Milford, Kans.	286
KFKQ	Conway Radio Laboratories.....Conway, Ark.	250
KFKV	F. F. Gray .....Butte, Mont.	283
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co., Colorado Springs, Colo.	234
KFLA	Abner R. Wilson.....Butte, Mont.	283
KFLB	Signal Electric Mfg. Co.....Menominee, Mich.	248
KFLD	Paul E. Greenlaw.....Franklinton, La.	234
KFLE	National Education Service.....Denver, Colo.	268
KFLH	Erickson Radio Co.....Salt Lake City, Utah	261
KFLQ	Bizzell Radio Shop.....Little Rock, Ark.	261
KFLR	University of New Mexico..Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House, San Benito, Tex.	236
KFLV	A. T. Frykman.....Rockford, Ill.	229
KFLW	Missoula Electric Supply Co...Missoula, Mont.	234
KFLX	George R. Clough.....Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.....Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.....Atlantic, Iowa	273
KFMB	Christian Churches of Little Rock, Little Rock, Ark.	254
KFMQ	University of Arkansas.....Fayetteville, Ark.	263
KFMR	Morningside College .....Sioux City, Iowa	261
KFMS	Freimuth Department Store.....Duluth, Minn.	275
KFMT	George W. Young.....Minneapolis, Minn.	231
KFMU	Stevens Bros. .....San Marcos, Tex.	240
KFMW	M. G. Satern.....Houghton, Mich.	266
KFMX	Carleton College .....Northfield, Minn.	283
KFMY	Boy Scouts of America.....Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club....Roswell, N. Mex.	250
KFNC	Alonzo Monk, Jr.....Corsicana, Tex.	234
KFNF	Henry Field Seed Co.....Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop.....Coldwater, Miss.	254
KFNH	State Teachers College.....Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop...Warrensburg, Mo.	234
KFNL	Radio Broadcast Association..Paso Robles, Calif.	240
KFNV	L. A. Drake.....Santa Rosa, Calif.	234
KFNX	Peabody Radio Service.....Peabody, Kans.	240
KFNY	Montana Phonograph Co.....Helena, Mont.	261
KFNZ	Royal Radio Co.....Burlingam, Calif.	231
KFOA	Rhodes Co. .....Seattle, Wash.	455
KFOC	First Christian Church.....Whittier, Calif.	236
KFOD	The Radio Shop.....Wallace, Idaho	224
KFOF	Rohrer Electric Co.....Marshfield, Ore.	240
KFOH	Radio Bungalow .....Portland, Ore.	283
KFOJ	Moberly High School Radio Club, Moberly, Mo.	246
KFOL	Leslie M. Schafbuch.....Marengo, Iowa	234
KFON	Echophone Radio Shop.....Long Beach, Calif.	234
KFOP	Wilson Construction Co.....Dallas, Tex.	268
KFPB	Edwin J. Brown.....Seattle, Wash.	224
KFPT	Cape & Johnson.....Salt Lake City, Utah	268
KFQE	Dickenson-Henry Radio Laboratories, Colorado Springs, Colo.	
KFQF	Donald A. Boult.....Minneapolis, Minn.	
KFSG	Echo Park Evangelistic Assn., Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger.....Tacoma, Wash.	252
KGG	Hallock Watson Radio Service...Portland, Ore.	360
KGN	Northwestern Radio Mfg. Co.....Portland, Ore.	360
KGO	General Electric Co.....Oakland, Calif.	312
KGU	Marion A. Mulrony.....Honolulu, Hawaii	360
KGW	Portland Morning Oregonian.....Portland, Ore.	492
KGY	St. Martins College.....Lacey, Wash.	258
KHJ	Times-Mirror Co. .....Los Angeles, Calif.	395
KHQ	Louis Wasmer .....Seattle, Wash.	360
KJQ	C. O. Gould.....Stockton, Calif.	273
KJR	Northwest Radio Service Co.....Seattle, Wash.	283
KJS	Bible Inst. of Los Angeles, Los Angeles, Calif.	360
KLS	Warner Bros. Radio Supplies Co., Oakland, Calif.	360
KLX	Tribune Publishing Co.....Oakland, Calif.	509
KLZ	Reynolds Radio Co.....Denver, Colo.	360
KMJ	San Joaquin Light & Power Corp., Fresno, Cal.	248
KMO	Love Electric Co.....Tacoma, Wash.	360
KNT	Walter Hemrich .....Kukak Bay, Alaska	263
KNX	Electric Lighting Supply Co., Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex.	360
KOP	Detroit Police Department.....Detroit, Mich.	286
KPO	Hale Bros. .....San Francisco, Calif.	423
KQP	Apple City Radio Club.....Hood River, Ore.	360
KQV	Doubleday-Hill Electric Co.....Pittsburgh, Pa.	270
KQW	Charles D. Herrold.....San Jose, Calif.	360
KRE	Berkeley Daily Gazette.....Berkeley, Calif.	275
KSD	Post-Dispatch.....St. Louis, Mo.	546
KTW	First Presbyterian Church.....Seattle, Wash.	360
KUO	Examiner Printing Co....San Francisco, Calif.	360
KUY	Coast Radio Co.....El Monte, Calif.	256
KWG	Portable Wireless Telephone Co., Stockton, Calif.	360
KWH	Los Angeles Examiner.....Los Angeles, Calif.	360
KYQ	The Electric Shop.....Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co., Chicago, Ill.	536
KZM	Preston D. Allen.....Oakland, Calif.	360
KZV	Wenatchee Bat. & Motor Co., Wenatchee, Wash.	360
WAAB	Valdemar Jensen .....New Orleans, La.	269
WAAC	Tulane University .....New Orleans, La.	360
WAAD	Ohio Mechanics Institute.....Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal....Chicago, Ill.	286
WAAM	I. R. Nelson Co.....Newark, N. J.	263
WAAN	University of Missouri.....Columbia, Mo.	254
WAAW	Omaha Grain Exchange.....Omaha, Nebr.	360
WABA	Lake Forest College.....Lake Forest, Ill.	266
WABB	Harrisburg Sporting Goods Co...Harrisburg, Pa.	266
WABD	Parker High School.....Dayton, Ohio	283
WABE	Y. M. C. A.....Washington, D. C.	283
WABG	Arnold Edwards Piano Co.....Jacksonville, Fla.	275
WABH	Lake Shore Tire Co.....Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co....Bangor, Me.	240
WABL	Connecticut Agricultural College...Storrs, Conn.	283
WABM	F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich.	254
WABN	Ott Radio (Inc.).....La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church, Rochester, N. Y.	283
WABP	Robert F. Weinig.....Dover, Ohio	266
WABQ	Haverford College Radio Club..Haverford, Pa.	261
WABR	Scott High School.....Toledo, Ohio	270
WABS	Essex Mfg. Co.....Newark, N. J.	244
WABT	Holliday-Hall .....Washington, Pa.	252
WABU	Victor Talking Machine Co.....Camden, N. J.	226
WABV	John H. DeWitt.....Nashville, Tenn.	263
WABW	College of Wooster.....Wooster, Ohio	234
WABX	Henry B. Joy.....Mount Clemens, Mich.	270
WABY	John Magaldi, Jr.....Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church.New Orleans, La.	263
WBAA	Purdue University .....West Lafayette, Ind.	360
WBAH	The Dayton Co.....Minneapolis, Minn.	417
WBAN	Wireless Phone Corporation.....Paterson, N. J.	244
WBAO	James Millikin University.....Decatur, Ill.	360
WBAP	Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.....Columbus, Ohio	390
WBAX	John H. Stenger, Jr.....Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.....New York, N. Y.	492
WBBA	Newark Radio Laboratories.....Newark, Ohio	240
WBBD	Barbey Battery Service.....Reading, Pa.	234
WBBF	Georgia School of Technology.....Atlanta, Ga.	270
WBBG	Irving Vermilya.....Mattapoisett, Mass.	248
WBBH	J. Irving Bell.....Port Huron, Mich.	246
WBBJ	Neel Electric Co.....West Palm Beach, Fla.	258
WBBL	Grace Covenant Church.....Richmond, Va.	283
WBBM	Frank Atlass Produce Co.....Lincoln, Ill.	226
WBBN	A. B. Blake.....Wilmington, N. C.	275
WBBO	Michigan Limestone & Chem. Co., Rogers, Mich.	250
WBBP	Petoskey High School.....Petoskey, Mich.	246
WBBQ	Frank Crook .....Pawtucket, R. I.	252
WBBR	Peoples Pulpit Association.....Rossville, N. Y.	273
WBBS	First Baptist Church.....New Orleans, La.	250
WBBT	Lloyd Bros. .....Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.....Monmouth, Ill.	224

WBBV	Johnstown Radio Co.....Johnstown, Pa.	248
WBBW	Ruffner Junior High School.....Norfolk, Va.	222
WBBY	Washington Light Infantry....Charleston, S. C.	268
WBBZ	Noble S. Watson.....Indianapolis, Ind.	227
WBS	D. W. May (Inc.).....Newark, N. J.	360
WBT	Southern Radio Corporation...Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337
WCAD	St. Lawrence University.....Canton, N. Y.	280
WCAE	Kaufmann & Bauer Co.....Pittsburgh, Pa.	462
WCAG	Clyde R. Randall.....New Orleans, La.	268
WCAH	Entrekin Electric Co.....Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University, University Place, Nebr.	360
WCAK	Alfred P. Daniel.....Houston, Tex.	263
WCAL	St. Olaf College.....Northfield, Minn.	360
WCAM	Villanova College .....Villanova, Pa.	360
WCAO	Sanders & Stayman Co.....Baltimore, Md.	360
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	469
WCAR	Southern Radio Corp. of Texas, San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute, Minneapolis, Minn.	280
WCAT	South Dakota State School of Mines, Rapid City, S. Dak.	240
WCAU	Durham & Co.....Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.....Little Rock, Ark.	360
WCAX	University of Vermont.....Burlington, Vt.	360
WCAZ	Carthage College .....Carthage, Ill.	246
WCBA	Charles W. Heimbach.....Allentown, Pa.	280
WCBC	University of Michigan.....Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva.....Zion, Ill.	345
WCBE	Uhalt Radio Co.....New Orleans, La.	263
WCBG	Howard S. Williams.....Pascagoula, Miss.	268
WCBH	University of Mississippi.....Oxford, Miss.	242
WCBM	Charles Schwarz.....Baltimore, Md.	360
WCBX	Radio Shop of Newark.....Newark, N. J.	233
WCBZ	Coppotelli Brothers' Music House, Chicago Heights, Ill.	
WCK	Stix-Baer & Fuller Dry Goods Co., St. Louis, Mo.	360
WCM	University of Texas.....Austin, Tex.	360
WCX	Detroit Free Press.....Detroit, Mich.	517
WDAE	Tampa Daily Times.....Tampa, Fla.	360
WDAF	Kansas City Star.....Kansas City, Mo.	411
WDAG	J. Laurance Martin.....Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South), El Paso, Tex.	268
WDAK	The Courant .....Hartford, Conn.	261
WDAO	Automotive Electric Co.....Dallas, Tex.	360
WDAP	Drake Hotel.....Chicago, Ill.	360
WDAR	Lit Brothers .....Philadelphia, Pa.	395
WDAS	Samuel A. Waite.....Worcester, Mass.	360
WDAU	Slocum & Kilburn.....New Bedford, Mass.	360
WDAY	Radio Equipment Corporation, Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.....Lancaster, Pa.	258
WDBL	Immanuel Lutheran Church of Valparaiso, Valparaiso, Ind.	
WDBP	Superior State Normal School, Superior, Wis.	
WDM	Church of the Covenant.....Washington, D. C.	234
WDZ	James L. Bush.....Tuscola, Ill.	278
WEAA	Frank D. Fallain.....Flint, Mich.	250
WEAF	American Tel. & Tel. Co....New York, N. Y.	492
WEAH	Wichita Board of Trade.....Wichita, Kans.	280
WEAI	Cornell University .....Ithaca, N. Y.	286
WEAJ	University of South Dakota..Vermilion, S. Dak.	283
WEAM	Borough of North Plainfield, North Plainfield, N. J.	286
WEAN	Shepard Co. .....Providence, R. I.	273
WEAO	Ohio State University.....Columbus, Ohio	360
WEAP	Mobile Radio Co.....Mobile, Ala.	360
WEAR	Evening News Publishing Co....Baltimore, Md.	261
WEAU	Davidson Bros. Co.....Sioux City, Iowa	360
WEAY	Iris Theater .....Houston, Tex.	360
WEB	Benwood Co. .....St. Louis, Mo.	273
WEBH	Edgewater Beach Hotel Co.....Chicago, Ill.	360
WEV	Hurlburt-Still Electrical Co.....Houston, Tex.	360
WEW	St. Louis University.....St. Louis, Mo.	280
WFAA	Dallas News and Dallas Journal...Dallas, Tex.	476
WFAB	Carl F. Woese.....Syracuse, N. Y.	234
WFAM	Times Publishing Co.....St. Cloud, Minn.	273
WVX	H. C. Spratley Radio Co...Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.....Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co., Asheville N. C.	360
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College.....Cameron, Mo.	360
WFAT	New Columbus College.....Sioux Falls, S. Dak.	258
WFAV	University of Nebraska.....Lincoln, Nebr.	275
WFI	Strawbridge & Clothier.....Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co., Lancaster, Pa.	248
WGAN	Cecil E. Lloyd.....Pensacola, Fla.	360
WGAQ	Glenwood Radio Corporation....Shreveport, La.	252
WGAW	Ernest C. Albright.....Altoona, Pa.	261
WGAZ	South Bend Tribune.....South Bend, Ind.	360
WGI	American Radio and Research Corporation, Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett.....Philadelphia, Pa.	360
WGN	Chicago Radio Laboratory.....Chicago, Ill.	448
WGR	Federal Tel. & Tel. Co.....Buffalo, N. Y.	319
WGV	Interstate Electric Co.....New Orleans, La.	242
WGY	General Electric Co.....Schenectady, N. Y.	380
WHA	University of Wisconsin.....Madison, Wis.	360
WHAA	State University of Iowa.....Iowa City, Iowa	484
WHAB	Clark W. Thompson.....Galveston, Tex.	360
WHAD	Marquette University .....Milwaukee, Wis.	280
WHAG	University of Cincinnati.....Cincinnati, Ohio	222
WHAH	Hafer Supply Co.....Joplin, Mo.	283
WHAK	Roberts Hardware Co.....Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music), Rochester, N. Y.	283
WHAR	Seaside House .....Atlantic City, N. J.	231
WHAS	Courier-Journal and Louisville Times, Louisville, Ky.	400
WHAV	Wilmington Elecl. Spec. Co., Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute....Troy, N. Y.	380
WHB	Sweeney School Co.....Kansas City, Mo.	411
WHK	Radiovox Co. .....Cleveland, Ohio	283
WHN	George Schubel .....New York, N. Y.	360
WIAB	Joslyn Automobile Co.....Rockford, Ill.	252
WIAC	Galveston Tribune .....Galveston, Tex.	360
WIAD	Howard R. Miller.....Philadelphia, Pa.	254
WIAF	Gustav A. DeCortin.....New Orleans, La.	234
WIAI	Heer Stores Co.....Springfield, Mo.	252
WIAJ	Fox River Valley Radio Sup. Co., Neenah, Wis.	224
WIAK	Journal-Stockman Co. .....Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee, Milwaukee, Wisc.	246
WIAQ	Chronicle Publishing Co.....Marion, Ind.	226
WIAS	Home Electric Co.....Burlington, Iowa	283
WIK	K. & L. Electric Co.....McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co., Washington, D. C.	360
WIP	Gimbel Bros. .....Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories..Waco, Tex.	360
WJAG	Norfolk Dairy News.....Norfolk, Nebr.	283
WJAK	Clifford L. White.....Greentown, Ind.	254
WJAM	D. M. Perham.....Cedar Rapids, Iowa	268
WJAN	Peoria Star .....Peoria, Ill.	280
WJAQ	Capper Publications .....Topeka, Kans.	360
WJAR	The Outlet Co.....Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	250
WJAT	Kelley-Vawter Jewelry Co.....Marshall, Mo.	360
WJAX	Union Trust Co.....Cleveland, Ohio	390
WJD	Denison University .....Granville, Ohio	229
WJX	Deforest Radio Tel. & Tel. Co., New York, N. Y.	360
WJY	Radio Corporation of America, New York, N. Y.	405
WJZ	Radio Corporation of America, New York, N. Y.	455
WKAA	H. F. Paar.....Cedar Rapids, Iowa	268
WKAD	Charles Looff (Crescent Park), E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co....Wichita Falls, Tex.	360
WKAN	United Battery Service Co....Montgomery, Ala.	226
WKAP	Dutee W. Flint.....Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico, San Juan, P. R.	360
WKAR	Michigan Agri. College, East Lansing, Mich.	280
WKAV	Laconia Radio Club.....Laconia, N. H.	254
WKY	WKY Radio Shop.....Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation, Minneapolis, Minn.	417
WLAH	Samuel Woodworth .....Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.....Waco, Tex.	360
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.....Tulsa, Okla.	360
WLAP	W. V. Jordon.....Louisville, Ky.	360
WLAQ	Arthur E. Schilling.....Kalamazoo, Mich.	283
WLAV	Electric Shop .....Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y., New York, N. Y.	360
WLAX	Putnam Electric Co.....Greencastle, Ind.	231
WLB	University of Minnesota....Minneapolis, Minn.	360
WLBL	Wisconsin Dept. of Markets..Stevens Point, Wis.	
WLW	Crosley Mfg. Co.....Cincinnati, Ohio	309
WMAB	Radio Supply Co.....Oklahoma, Okla.	360
WMAC	Clive B. Meredith.....Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.....Dartmouth, Mass.	360
WMAH	General Supply Co.....Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.....Kansas City, Mo.	275
WMAK	Norton Laboratories.....Lockport, N. Y.	273
WMAL	Trenton Hardware Co.....Trenton, N. J.	256
WMAN	First Baptist Church.....Columbus, Ohio	286
WMAQ	Chicago Daily News.....Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute....Auburn, Ala.	250
WMAY	Kingshighway Presby. Church, St. Louis, Mo.	280
WMC	Commercial Appeal .....Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co., Washington, D. C.	261
WNAC	Shepard Stores .....Boston, Mass.	278
WNAD	University of Oklahoma.....Norman, Okla.	360
WNAL	R. J. Rockwell.....Omaha, Nebr.	266
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.	286
WNAP	Wittenberg College .....Springfield, Ohio	275
WNAQ	Charleston Radio Elec. Co.....Charleston, S. C.	360
WNAR	C. C. Rhodes.....Butler, Mo.	231
WNAS	Texas Radio Corp. and Austin Statesman, Austin, Tex.	360
WNAT	Lenning Brothers Co.....Philadelphia, Pa.	360
WNAV	Peoples Tel. & Tel. Co.....Knoxville, Tenn.	236
WNAW	Henry Kunzman....Box 167, Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co., Yankton, S. Dak.	244
WNYC	Municipality of New York.....New York City	526
WNJ	Shotton Radio Mfg. Co.....Albany, N. Y.	360
WOAC	Page Organ Co. (H. P. Maus).....Lima, Ohio	266
WOAE	Midland College .....Fremont, Nebr.	360
WOAF	Tyler Commercial College.....Tyler, Tex.	360
WOAG	Apollo Theater .....Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation...Charleston, S. C.	360
WOAI	Southern Equipment Co.....San Antonio, Tex.	385
WOAN	James D. Vaughn.....Lawrenceburg, Tenn.	360
WOAQ	Lyradion Mfg. Co.....Mishawaka, Ind.	360
WOAR	Kalamazoo College .....Kalamazoo, Mich.	283
WOAT	Henry P. Lundskow.....Kenosha, Wis.	229
WOAV	Boyd M. Hamp.....Wilmington, Del.	360
WOAW	Pennsylvania Nat. Guard, 112th Inf...Erie, Pa.	242
WOAX	Woodmen of the World.....Omaha, Nebr.	526
WOC	Franklyn J. Wolff.....Trenton, N. J.	240
WOI	Palmer School of Chiropractic..Davenport, Iowa	484
WOK	Iowa State College.....Ames, Iowa	360
WOO	Pine Bluff Co.....Pine Bluff, Ark.	360
WOQ	John Wanamaker .....Philadelphia, Pa.	509
WOR	Western Radio Co.....Kansas City, Mo.	360
WOS	L. Bamberger & Co.....Newark, N. J.	405
WPAB	Missouri State Market'g Bu., Jefferson City, Mo.	441
WPAC	Pennsylvania State College...State College, Pa.	283
WPAJ	Donaldson Co. .....Okmulgee, Okla.	330
WPAK	Doolittle Radio Corp.....New Haven, Conn.	268
WPAL	North Dakota Agricultural College, Agricultural College, N. Dakota	360
WPAM	Avery & Loeb Electric Co.....Columbus, Ohio	286
WPAT	Auerbach & Guettel.....Topeka, Kans.	360
WPAU	St. Patrick's Cathedral.....El Paso, Tex.	360
WPAZ	Concordia College .....Moorhead, Minn.	360
WQAA	John R. Koch.....Charleston, W. Va.	273
WQAC	Horace A. Beale, Jr.....Parkesburg, Pa.	360
WQAE	E. B. Gish.....Amarillo, Texas	234
WQAF	Moore Radio News Station.....Springfield, Vt.	275
WQAL	Sandusky Register .....Sandusky, Ohio	240
WQAM	Coles County Tele. & Teleg. Co., Mattoon, Ill.	258
WQAN	Electrical Equipment Co.....Miami, Fla.	283
WQAO	Scranton Times .....Scranton, Pa.	280
WQAQ	Calvary Baptist Church.....New York, N. Y.	360
WQAS	W. Texas Radio Co. (Abilene Dairy Reporter), Abilene, Texas	360
WQAW	Prince-Walter Co. .....Lowell, Mass.	266
WQAX	Catholic University.....Washington, D. C.	236
WQJ	Radio Equipment Co.....Peoria, Ill.	360
WRAA	Calumet Rainbow Broadcasting Co., Chicago, Ill.	
WRAF	Rice Institute .....Houston, Texas	360
WRAH	The Radio Club.....Laporte, Ind.	224
WRAL	Stanley N. Read.....Providence, R. I.	231
WRAM	Northern States Power Co., St. Croix Falls, Wis.	248
WRAN	Lombard College .....Galesburg, Ill.	244
WRAO	Black Hawk Electrical Co.....Waterloo, Iowa	236
WRAV	St. Louis Radio Service Co.....St. Louis, Mo.	360
WRAW	Antioch College .....Yellow Springs, Ohio	242
WRAX	Avenue Radio Shop.....Reading, Pa.	238
WRAY	Flexon's Garage .....Gloucester City, N. J.	268
WRC	Radio Sales Corporation.....Scranton, Pa.	280
WRK	Radio Corporation of America, Washington, D. C.	469
WRL	Doron Bros. Electrical Co.....Hamilton, Ohio	360
WRM	Union College .....Schenectady, N. Y.	360
WRR	University of Illinois.....Urbana, Ill.	360
WRW	City of Dallas, Police and Fire Signal Dept., Dallas, Texas	360
WSAB	Tarrytown Radio Res'ch Lab., Tarrytown, N. Y.	273
WSAC	Southeast Missouri State Teachers College, Cape Girardeau, Mo.	360
WSAD	Clemson Agricultural Col., Clemson College, S. C.	360
WSAG	J. A. Foster Co.....Providence, R. I.	261
WSAI	Loren V. Davis and George Prestman, Sr., St. Petersburg, Fla.	244
WSAJ	United States Playing Card Co., Cincinnati, O.	309
WSAN	Grove City College.....Grove City, Pa.	360
WSAP	Allentown Radio Club.....Allentown, Pa.	229
WSAR	Seventh Day Adventist Temple.....N. Y. City	263
WSAT	Doughty & Welch Elec. Co., Fall River, Mass.	254
WSAY	Donohoo-Ware Hardware Co....Plainview, Tex.	268
WSAZ	Port Chester Chamber of Commerce, Port Chester, N. Y.	233
WSB	Chase Electric Shop.....Pomeroy, Ohio	258
WSL	Atlanta Journal .....Atlanta, Ga.	429
WSY	J. & M. Electrical Co.....Utica, N. Y.	273
WTAC	Alabama Power Co.....Birmingham, Ala.	360
	Penn Traffic Co.....Johnstown, Pa.	275
WTAF	Louis J. Gallo.....New Orleans, La.	268
WTAG	Kern Music Co.....Providence, R. I.	258
WTAJ	The Radio Shop.....Portland, Me.	236
WTAL	Toledo Radio & Electric Co.....Toledo, Ohio	252
WTAM	Willard Storage Battery Co.....Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co..Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son.....Osseo, Wis.	254
WTAR	Reliance Electric Co.....Norfolk, Va.	280
WTAS	Charles E. Erbstein.....Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co., Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co..Tecumseh, Nebr.	242
WTAW	Agricultural and Mechanical College of Texas, College Station, Tex.	280
WTAX	Williams Hardware Co.....Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station, Oak Park, Ill.	283
WTAZ	Thomas J. McGuire.....Lambertville, N. J.	283
WTG	Kansas State Agricultural College, Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co.....Trenton, N. J.	226
WWAC	Sanger Bros. .....Waco, Tex.	360
WWAD	Wright & Wright (Inc.).....Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley.....Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.....Camden, N. J.	236
WWAO	Michigan College of Mines....Houghton, Mich.	244
WWI	Ford Motor Co.....Dearborn, Mich.	273
WWJ	Detroit News .....Detroit, Mich.	517
WWL	Loyola University .....New Orleans, La.	280

Canadian Stations

CKLC	Wilkinson Electric Co., Ltd.....Calgary, Alta.	400
CJCD	T. Eaton Co., Ltd.....Toronto, Ont.	410
CFCU	Jack V. Elliot, Ltd.....Hamilton, Ont.	410
CFLC	Chas. Guy Hunter.....London, Ont.	430
CHCS	The Hamilton Spectator.....Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd....Montreal, P. Q.	341
CFCF	Marconi W/T Co. of Can., Ltd., Montreal, P. Q.	440
CKCO	Dr. G. M. Geldert.....Ottawa, Ont.	400
CHNC	Toronto Radio Research Society, Toronto, Ont.	350
CKCH	Canadian National Railways.....Ottawa, Ont.	435
CJCM	J. L. Philippe Landry.....Mont Joli, P. Q.	312
CHXC	J. R. Booth, Jr.....Ottawa, Ont.	435
CHCE	Western Canada Radio Supply, Victoria, B. C.	400
CKY	Manitoba Telephone System....Winnipeg, Man.	450
CKCD	Vancouver Daily Province....Vancouver, B. C.	410
CFCA	Star Publishing & Printing Co., Toronto, Ont.	400
CFAC	The Calgary Herald.....Calgary, Alta.	430
CKAC	La Presse Publishing Co., Ltd., Montreal, P. Q.	430
CFCH	Abitibi Power & Paper Co., Ltd., Iroquois Falls, Ont.	400
CJCF	The News Record.....Kitchener, Ont.	295
CJGC	London Free Press Printing Co., Ltd., London, Ont.	430
CFRC	Queen's University.....Kingston, Ont.	450
CFCQ	Radio Specialties, Ltd.....Vancouver, B. C.	450
CFDC	Sparks Company .....Nanaimo, B. C.	430
CJCA	The Edmonton Journal, Ltd....Edmonton, Alta.	450
CFCK	Radio Supply Co., Ltd.....Edmonton, Alta.	410
CJCE	Sprott Shaw Radio Co.....Vancouver, B. C.	400
CFCL	Centennial Methodist Church.....Victoria, B. C.	400
CJSC	The Evening Telegram.....Toronto, Ont.	430
CFYC	Victor Wentworth Odlum.....Vancouver, B. C.	400
CFXC	Westminster Trust Co...New Westminster, B. C.	440
CKCI	Le "Soleil" Limitee.....Quebec, P. Q.	295
CFQC	The Electric Shop, Ltd.....Saskatoon, Sask.	400
CHBC	The Albertan Publishing Co.....Calgary, Alta.	410

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station).....	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower).....	2,600
8AJ	Paris	1,780
ESP	Paris	450

Cuban Stations

PWX	Cuban Telephone Co.....Habana	400
2DW	Pedro Zayas .....Habana	300
2AB	Alberto S. de Bustamante.....Habana	240
2OK	Mario Garcia Vélez.....Habana	360
2BY	Frederick W. Borton.....Habana	260
2CX	Frederick W. Borton.....Habana	320
2EV	Westinghouse Elec. Co.....Habana	220
2TW	Roberto E. Ramirez.....Habana	230
2HC	Heraldo de Cuba.....Habana	275
2LC	Luis Casas .....Habana	250
2KD	E. Sanchez de Fuentes.....Habana	350
2MN	Fausto Simon .....Habana	270
2MG	Manuel G. Salas.....Habana	280
2JQ	Raul Pérez Falcon.....Habana	150
2KP	Alvaro Daza .....Habana	200
2HS	Julio Power .....Habana	180
2OL	Oscar Collado .....Habana	290
2WW	Amadeo Saenz .....Habana	210
5EV	Leopold V. Figueroa.....Colon	360
6KW	Frank H. Jones.....Tuinucu	340
6KJ	Frank H. Jones.....Tuinucu	275
5EV	Leopoldo V. Figueroa.....Colon	360
6DW	Eduardo Terry.....Cienfuegos	225
6BY	José Ganduxe .....Cienfuegos	300
6AZ	Valentin Ulivarri .....Cienfuegos	200
6EV	Josefa Alvarez .....Caibarién	225
7AZ	Pedro Nogueras .....Camaguey	225
7BY	Salvador Dionda .....Camaguey	350
8AZ	Alfredo Broocks .....Santiago de Cuba	240
8BY	Alberto Ravelo .....Santiago de Cuba	250
8FU	Andrés Vinnet .....Santiago de Cuba	225
8DW	Pedro C. Anduz .....Santiago de Cuba	275
8EV	Eduardo Mateos .....Santiago de Cuba	180
8GT	Juan F. Chibas .....Santiago de Cuba	260

The Daven Radio Type 3-C Amplifier Kit

as illustrated, contains all the parts necessary to build a three stage *resistance coupled amplifier*. It is packed in a neat compartment box with full directions for assembly and operation with any detector and tuner.

Price Complete $13.50

THE IDEAL BROADCAST AMPLIFIER

Only an amplifier that can reproduce a woman's voice with the sweetness and color of reality—the mellow richness of the contralto, the piercing beauty of the coloratura soprano—is worthy of being called "IDEAL." This is the acid test of amplifiers. Almost all amplifying systems fail before it, and only the *resistance coupled amplifier* passes the test consistently, economically and invariably.

The Daven Radio Resistance Coupled Amplifiers

bring forth a new quality and beauty from every receiver, the most lowly or the most pretentious—a purity of tone that rarely passes the first tube. To the laymen, the *resistance coupled amplifier* is a revelation, to the virtuoso it is the realization of that subtle perfection that he alone appreciates!

Read our booklet, "Resistors—Their Application to Radio Reception" By Zeh Bouck. Price 15 cents.

DAVEN RADIO CORP.

Resistor Specialists

11 CAMPBELL STREET, NEWARK, N. J.

Information Desk

(*Continued from page 64*)

of the order of .00008 mfd. and for the 201A is .00010 mfd. The feedback is induced into the grid circuit by placing a variable inductance—which in this case is a variometer—in the plate circuit of the detector tube. The tickler coil circuit, however, is preferable to the variometer tuned, because the latter has too much effect on the wavelength and is not to be recommended.

Charles Yerrick of Fort Worth, Texas, wishes to know how to add two stages of tuned radio frequency to his present detector and amplifier unit.

The diagram for this is shown in figure 2. The transformers shown are exactly like the

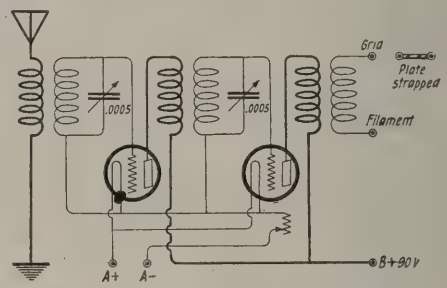


Figure 2—Tuned radio frequency circuit

astatic transformers shown in the D-coil Receiver in the June issue of THE WIRELESS AGE. The coils are wound on 3-inch tubing slotted at opposite sides of the diamteer with a slot ½-inch wide and the primary wound with 12 turns of No. 20 D.C.C. or D.S.C. wire and the secondary wound with 60 turns of the same size wire. The windings are separated ⅜-inch. With this number of turns a .0005 mfd. variable condenser will tune to the entire broadcast wavelength band and the need for the .001 mfd. condensers will be obviated.

Mr. W. J. Udick of Pittsburgh, Pa., writes, "I have started to build the 'D' coil receiver described in the May issue of THE WIRELESS AGE, *but find that you did not mention the ratio of the audio-frequency transformer. I would also like to know where the B minus is connected."*

The ratio of the audio-frequency transformers can be anything from 5-to-1 to 10-to-1 in the first stage and preferably a 3½-to-1 or 4-to-1 in the second stage. In Mr. McIlvain's set two Acme audio-frequency transformers were used each having a ratio of 3½-to-1. The negative B should be connected to the positive of the A battery as in all amplifiers.

Reinartz 10-Meter Radio Transmitter

IN a short acceptance speech after receiving the Radio Cup, an annual award of the Executive Radio Council, Second District, given to the radio amateur whose experimental work during the year most befits him for the honor, John L. Reinartz, recognized radio engineer and amateur radio experimenter declared at a monster convention of radio amateurs from the Metropolitan area that he had turned over to the Navy Department his en-

N&K Imported LOUDSPEAKER

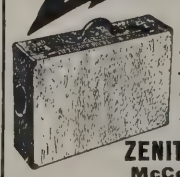
TYPE W

Watch for announcement in the September magazines. New in principle, new in shape, new in quality of reproduction, price $27.50. *Made by the makers of the famous N & K Head Set, Model D. 4000 ohms, price* $8.50.

TH. GOLDSCHMIDT CORP.
Dept. W8, 15 William St., New York

ZENITH Super-Portable

A six-tube radio set, completely self-contained. Does not need to be opened to operate. Write today for full particulars and name of nearest dealer.



ZENITH RADIO CORPORATION
McCormick Building, Chicago

tire developments on a radio transmitter functioning on 10 meters. He further declared that his system could be adapted to any amateur station operating today, within less than ten minutes. Previously, radio communication on 100 meters was considered epoch-marking. At this high frequency, special insulation is necessary, as bakelite bursts.

President W. J. Howell of the Executive Radio Council presented Reinartz with the cup before several hundred cheering amateurs gathered at the Convention Hall of Seaman's Church Institute, 25 South Street, Saturday, June 7th. Reinartz was selected for the award for his short-wave transmission and reception experiments. Preceding the award, Boyd Phelps, Wm. Diehl, J. Clark, P. Willis delivered technical papers.

Broadcasting Senate Proceedings

(*Continued from page* 30)

fold intensified. Senators and Representatives would hear oftener and more promptly from their electorate as a result of this innovation.

The great value, of course, of broadcasting the Senate's proceedings lies in the educational factor. We need more general and intensive public knowledge of what the great public questions are. Extend this proposal to the courts and legislatures of all the states. Let one's imagination add to that the probability of radio photography and radio vision, so that one might see, as well as hear what these agencies are doing, and even the most conservatively thinking person will see that a great improvement in our government and its workings is bound to take place.

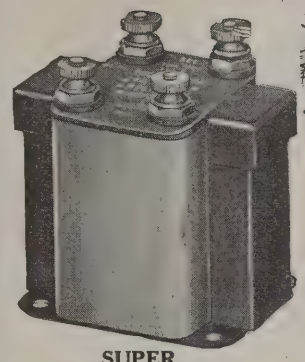
I believe that broadcasting of the proceedings of Congress is coming and that it will be very beneficial to the country."

Broadcasting Senate Proceedings

(*Continued from page* 31)

bureau would immediately develop. Parties and politics are essential if a country is to keep out the morass such as some unfortunate lands are now suffering in. But politics simply for its own sake has no justification and it should not be permitted to hamper business legislation. I am afraid that much of the time of the Senate would be wasted under any such arrangement in purely political activity.

The educational value of this proposal I think is not large. One has but to read the *Congressional Record* to



SUPER TRANSFORMER
(audio frequency)

The Mirror of the Broadcasting Studio

"Why, Charles, that musical reproduction is perfect. Can that be our old set? It looks the same but how different it sounds. We were never able to get such perfect music before. It seems as though the artists were right here in the room. What *have* you done?"

"Simplest thing in the world, Mary. The boys at the office have been talking Thordarson Amplifying Transformers so hard that I decided to install them in place of my old ones. I see now that it was a wise move."

* * *

The Super Transformer is indeed the mirror of the Broadcasting Studio. It was designed with one primal aim—perfect reproduction. It has the same function in a radio set that the reproducer has on your phonograph. Install a pair—it will take you but a few minutes—and you will marvel at the rich musical quality obtained.

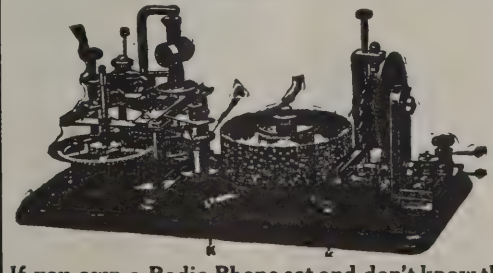
Kennedy, Zenith, Radiodyne and many other leading set manufacturers use the Thordarson Super Transformer in their apparatus. That's irrefutable proof of Thordarson superiority.

THORDARSON ELECTRIC MFG. CO.

Huron and Kingsbury Streets **Chicago, Ill.**

Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"



THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. **THE OMNIGRAPH** is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. **THE OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses **THE OMNIGRAPH** to test all applicants applying for a Radio license. **THE OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models.

DO IT TODAY.

THE OMNIGRAPH MFG. CO.
16B Hudson St. New York City

If you own a Radio Phone set and don't know the Code—you are missing most of the fun

A MANUFACTURERS' EXPOSITION
WHICH WILL BE ATTENDED BY THE PRINCIPAL
RADIO JOBBERS AND DEALERS OF THE UNIVERSE

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Representative Displays By The Famous Manufacturers Of
ENGLAND ∴ FRANCE ∴ BELGIUM
ITALY ∴ SWITZERLAND ∴ AUSTRIA

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U. J. Herrmann and James F. Kerr

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Hotel Prince George,
New York City.

know that many, many pages must be plowed through in order to procure the coveted information sought for. Much of the labor of the Senate is merely routine, of no particular interest to most people. Yet it is business which must be consummated, and it would of course come over the radio. Sometimes the pace of the proceedings is extremely rapid, and in these cases, especially when, for example, bills on the unanimous consent calendar are being considered—to make the case emphatic, at night sessions—radio would be impossible even with the most perfect equipment, operators and atmospheric conditions. Why, the Senate passed, as I recall, ninety-four bills at one session!

Improvement in the knowledge of the public as to things political will come not only from the reading and hearing of the news of the day's proceedings. We need now in this country a return to the fundamentals of our Constitution. The study of the basis of the government takes much time and thought and contemplation; such a process and avocation is far removed in character from broadcasting the Senate's proceedings.

The House of Representatives could, of course, decide also to broadcast its proceedings. The Supreme Court might like the notion. Each state legislature would undoubtedly be interested. The advertising opportunities are so full of potentialities. One can easily see that there would be practically no end to the train of eventualities of the Senate's approval of this proposal.

Radio has accomplished wonders for mankind. Its possibilities, are, of course, still mostly in the future. We have hardly scratched the uppermost surface.

However, I can see no good results accruing from broadcasting the proceedings of the Senate, and I can see many disadvantages resulting from any such unlikely decision.

A Radio System Built of Air-Castle Dreams

(*Continued from page* 29)

There being no available source of suitable electric energy, a separate electrical generator plant had to be provided. This contains two engines, one a Diesel, and the other a steam turbine, each of 750 horsepower. The Alexanderson alternators are 200 kilowatts each.

* * *

Although Mr. Alexanderson has been associated with the great strides made in power transmission, his radio researches have by no means been con-

IMPORTANT ANNOUNCEMENT
Soon to Be Made
NATANN Battery Charger
THREE STYLES
Listing $22.00, $17.50, $13.50
NATANN CO.
30 Front St. Brooklyn, N. Y.

PERFECT EMPIRE INSULATOR
EMPIRE
Oiled Tubing
Real Radio Sets of today—the kind that last long and work best—are insulated with genuine Empire Oiled Tubing.
MICA INSULATOR CO.
68 Church St. New York
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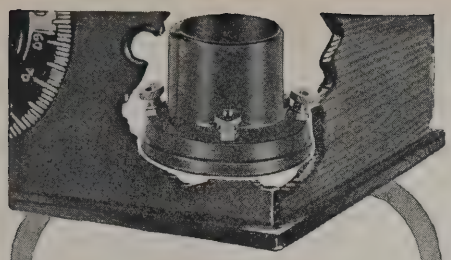


Get Directly at Them

Are the contacts in the sockets of your radio set easily accessible for ordinary and necessary cleaning?

With Na-ald DeLuxe Sockets in use you need neither sandpaper or an extra reach to keep contact strips and tube terminals bright and clean.

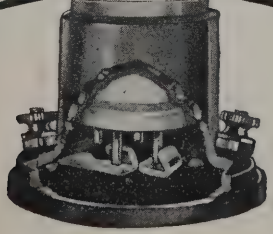
Just rotate the tube three or four times. Instantly the dual-wipe laminated contacts remove corrosion, making a bright perfect connection. This action is on the side of the tube terminals away from the soldered ends. *"It's the contact that counts."*

Make your Superheterodyne set free from socket trouble by using Na-ald De Luxe Sockets.

Sockets and panel mounts for all tubes. Prices 35c to 75c. Send for catalog.

ALDEN MANUFACTURING CO.
Dept. A SPRINGFIELD, MASS.

NA-ALD



New! —*A Calibrated Grid Leak!!*

You set it for a specified resistance and adjust it for best results. You read the resistance in exact terms of the megohm through a peep-hole in the panel. (It's also equipped for table mounting.) Each FIL-KO-LEAK is individually hand-calibrated in the laboratory. Resistance element is constant and accurate, and is not affected by atmospheric conditions or wear. The FIL-KO-LEAK assures you smooth, gradual control of resistance. You will get both distant and local stations with greater clarity and volume than ever before, for when the negative bias on the grid of the detector tube is *precisely right* the tube neither "chokes" nor "spills over". The improvement will be most noticeable on the *weakest* stations.

Every FIL-KO-LEAK is guaranteed to be perfect electrically and mechanically, and to be accurately calibrated over the operating range for all tubes (¼ to 5 megohms). This calibration is doubly checked before the instrument is shipped.

FIL-KO-LEAK
SCIENTIFICALLY CORRECT VARIABLE GRID LEAK

1.50

—With the $100 Guarantee

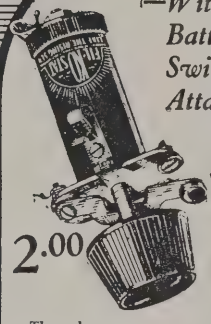
Bakelite Insulation Hermetically Sealed

Solid Brass Mounting Bracket

Absolutely warranted to protect your set from lightning, with a guarantee to pay you $100 or to repair your set, should it be damaged through faulty operation of the arrester.

The "umbrella" shield keeps dust, moisture, etc., from the insulation, preventing leakage losses from aerial to ground. This makes certain that all radio impulses reaching the antenna pass through your set, which assures maximum reception.

FIL-KO-A *LIGHTNING* **ARRESTER**
SCIENTIFICALLY CORRECT RADIO LIGHTNING ARRESTER



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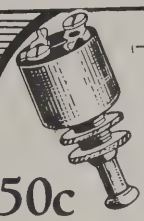
—With Battery Switch Attached

Supremacy proven by every test

Carries the usual FIL-KO-PARTS *unconditional guarantee.*

The only compression type rheostat with a battery switch attachment. Combines the advantages of infinite control of filament current with the simplicity of an ordinary battery switch. And at no extra cost! If you want perfect control of any type tube in any hook-up—if you want freedom from tube noises—if you want DX stations you never heard before — maximum signal strength—longer tube and battery life—then you *must* use FIL-KO-STAT. Battery switch attaches to regular FIL-KO-STAT mounting screws. No extra holes to drill.

FIL-KO-STAT
SCIENTIFICALLY CORRECT RADIO RHEOSTAT



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RADIO AMATEURS TALK 7,000 MILES FOR 2 HOURS

Argentinian and New Zealander Establish What Is Declared a Record for Non-Professionals.

BUENOS AIRES, May 24 (Associated Press).—Carlos Braggio of Bernal, near here, and Ivan O'Meara of Gisborne, New Zealand, radio amateurs with 7,000 miles of South American continent and Pacific Ocean between them, conversed for two hours by radio Thursday morning, establishing what is claimed to be a world's amateur radio record.

Braggio, who knows English, had spent most of the night unsuccessfully attempting to get some North American amateur to answer the signals of his station, CBZ8, when at 4 o'clock in the morning he was amazed to receive an answer from the other side of the globe —O'Meara's station, 2AC.

The amateurs opened a conversation which continued until 6 o'clock, when Braggio told O'Meara he had been up all night and wanted to go to bed. The New Zealander answered that he was sorry because it was only 9 o'clock in the evening at Station 2AC. Later on Thursday, Braggio received a congratulatory cable from O'Meara, confirming the conversation.

In connection with the radio communication test inaugurated this week with the United States, Argentine amateurs are unable to understand why they are able to get signals from North American amateurs while the latter apparently are unable to get theirs, although some of the Argentine stations are more powerful than some of the American ones which have been heard.

It is believed that many of the powerful broadcasting stations operating in the United States nightly interfere with the Argentine waves. In the future Braggio will try sending on a 120 meter wave-length at 3 A. M., Eastern Standard Time.

Argentinian and Jerseyite Exchange Radio Greetings

Special to The New York Times.

HARTFORD, Conn., June 2.—Two-way radio communication by amateurs between North and South America was attained for the first time last week by Norman R. Weible of Collingwood, N. J., and Carlos Braggio of Bernal, suburb of Buenos Aires. The feat was checked and verified today by the American Radio Relay League of this city, which tonight announced that Weible and Braggio had a twenty-minute connection on short wave lengths just before daybreak last Friday.

Braggio heard the New Jersey amateur calling him, and at 4:15 A. M. sent the following: "GM greetings and congratulations QRZ QRK."

Weible immediately replied in Spanish, "Saludo, Amigo de America del sur QRK."

A letter dated May 21, received today from E. J. Simmonds, an English amateur, stated he had heard the South American station transmitting.

Mr. Braggio Used

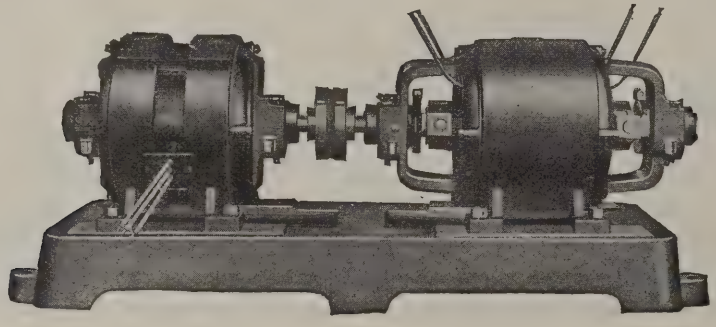
"ESCO"

Item 37—Double Commutator
1000 V. 600 W. for Plate
12 V. 300 W. for Filament

He writes:

"If I have the luck to be heard in the U. S. a great part of the success will be due to the good capacity of the **"ESCO"** *set."*

This is Item 37, used by CBZ8



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fined to that branch of engineering. He has carried out extensive development and research work in connection with radio receiving apparatus.

During the war, he evolved what has been aptly termed the "Barrage Method of Radio Reception." The immediate object of this receiving system was to eliminate malicious radio interference of the enemy who might send out waves of the same or nearly the same wave length as those which it was desired to receive.

Through an ingenious combination of receiving aerial systems and special apparatus, he was not only enabled to eliminate such interference, but to receive signals from European stations, nearby to a high power transmitting station in the United States which operated on the same wave length as that of the station received.

Further researches of vital importance were conducted by Mr. Alexanderson that led to the evolution of the duplex radio telephone system by which a subscriber to a land line telephone could establish connection with a radio telephone station and conduct a two-way conversation with the facility of an ordinary land-line circuit.

The two phases of this system of duplex radio telephony are classified by Mr. Alexanderson as the "bridge receiver" and the "barrage receiver."

The bridge receiver is a device which permits reception of signals at a given station while the transmitter at that station is in operation. This is accomplished by erecting a separate receiving and transmitting antenna, but placing them close enough together to gain the approximate effect of a Wheatstone bridge, the receiver and transmitter being so paired that a "balance" is obtained.

The barrage receiver is a combination of two aperiodic horizontal antennas. These have a unilateral directional characteristic. By the means of appropriate phase shifting devices, signals from any given direction can be balanced out while the desired signal is retained.

And so it is that many of us have come to know of rapid strides in the telegraphic and telephonic progress of radio, and have learned to use many of the service systems, of which many could be traced back to the tremendous activity of E. F. W. Alexanderson, and yet those are the ones of us who have failed to realize the romance of their origin, or the adventurous sojourns into the realm of science that lured this great personality to seek the unexplored and accomplish the impossible.

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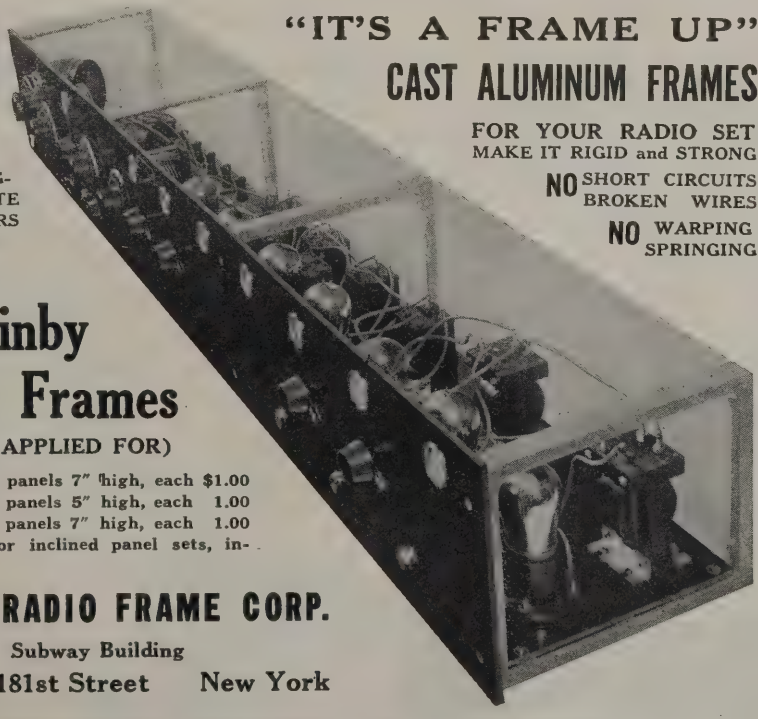

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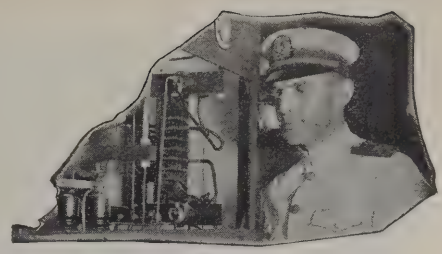

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Alexanderson's exploits, we stroll into the United States Patent Office and find more than 100 patents granted to him during the course of a few years. Along with this extensive program, we find that he has had time to present more than twenty scientific papers before the American engineering societies and through the technical press. And all of them bearing upon principles and practice in power engineering and radio telegraphy and telephony.

Then we drop in to visit Mr. Alexanderson. Busy? Of course! But we are cordially received, comfortably seated, and immediately put at our ease by this very human mortal. Lo! he is one of us. His interest centers on boats — big boats this time — but after all, what *is* the difference between boyhood, hand-whittled ships, and modern battle-cruisers? A small difference in our ages, perhaps.

Mr. Alexanderson tells us about his experiments in electric motor propulsion of battleships in the U. S. Navy. The New Mexico and other battleships of that type are now electrically propelled by apparatus designed by him. His attention was also directed to electrical propulsion of freight and passenger ships with the result that a large Japanese transport and many other privately owned ships now receive their motive power electrically.

Here, indeed, is a man whose enterprise and versatility and remarkable achievements amount to a thorough review of electrical and radio development, but a review that is indelibly associated with the growth and development of a personality.

The ABC of Your "C," "B" and "A" Batteries

(*Continued from page 69*)

volts are required, the desired amount of voltage may be tapped off in accordance with figure 1 for C battery.

When the battery requires recharging, the C battery cells should be thrown in series and the entire battery recharged just the same as though it were a standard 48-volt B battery.

In figure 1 the alternative connection A shows the C battery as a part of the regular B battery and is recommended where a radio set is so wired that the negative A and negative B battery are connected together.

For proper operation as a C battery the negative B lead is extended to any number of cells which are to be used as a C battery. In this particular diagram, six volts or three cells are utilized. However, this hook-up should not be used where the negative B battery lead goes to the positive A.

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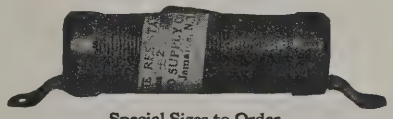

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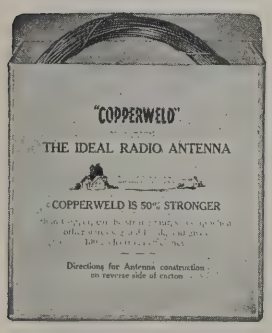
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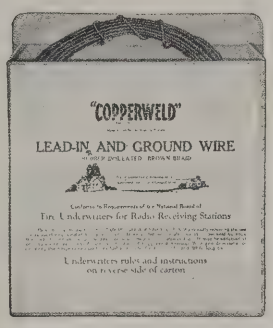

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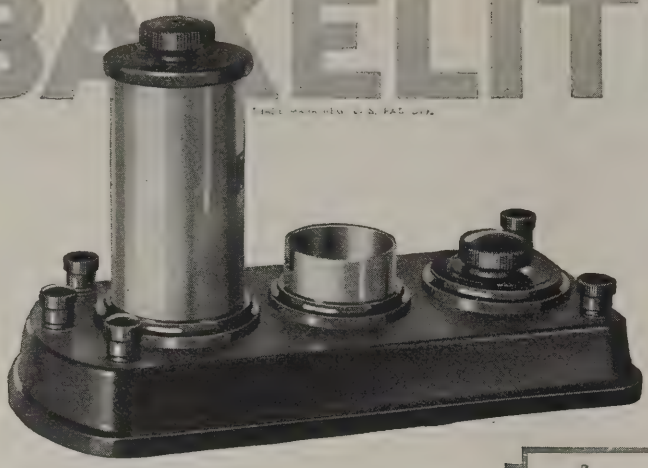

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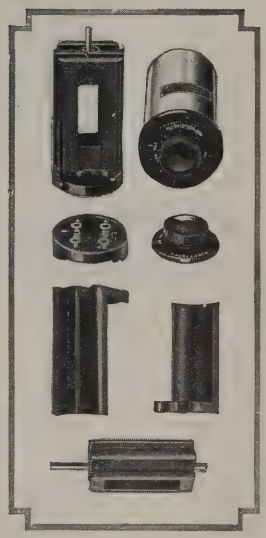

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32 PARK PLACE NEW YORK

Radio in the Canadian Wilderness

(*Continued from page 37*)

around us to stare at our radio and speculate about its performance, but none seemed the least disposed to do anything more about it. So the Doc and I let the matter rest there.

The town of Roberval is a small clearing in the heart of a vast forest. The people are mostly of French extraction and were not particularly cordial. They were probably a little shy in front of strangers. It is true that few people from the outside world, especially from the United States, ever visit this town. Like most of the French-Canadian villages, this one is dominated by a church at the head of the main street. The conspicuous abscence of trees mark the fear of the forest, common to most French-Canadians. To stay in a lumber camp during the season is, to these people, a feat that proves beyond question, the full manhood of the one who can do it.

On the train back to Chicoutimi, we saw a few lumberjacks who were returning from camp. The wild, uncouth manner of those men unmistakably branded them with the supreme hardship of that existence. Few care to pursue the calling over one or two seasons at the most.

When Dr. Hobart and I finally arrived in Montreal, we agreed that a trip into the Canadian wilderness is really worth while. The more so, with radio. Our next trip there will include a better receiver. Probably, an RCA portable Super-Heterodyne.

Moose and Music in Maine

(*Continued from page 51*)

the set would capture some of them. I lit the tubes—all six of them—and turned the dials half-heartedly.

Without a word of warning the loud-speaker emitted a ribald squeal which suddenly merged into and disappeared from among the strains of a jazz song—the most wonderful sounds I have ever in all my life heard.

I stood inarticulate, my feelings were chaotic with mingled glee, amazement, shock and triumph. For a full minute I stood with open mouth, grasping the realization that what I heard was genuinely true. As suddenly at it had left me the power of speech returned, and as the yell finally passed my lips I turned to the door to see Totum staring pop-eyed over a rather small spread of moose-antlers.

I was the first to break the silence.

"So you got one, did you?"

Without moving his eyes which were fixed in mute inquiry in the direction of the loud-speaker, Totum responded:

"Uh-huh. You kill him. He ran mile or two. One shot—not so bad."

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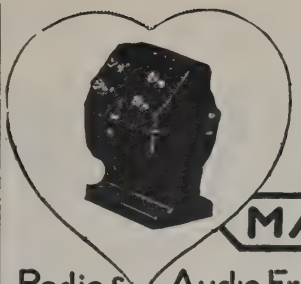

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See page 6.

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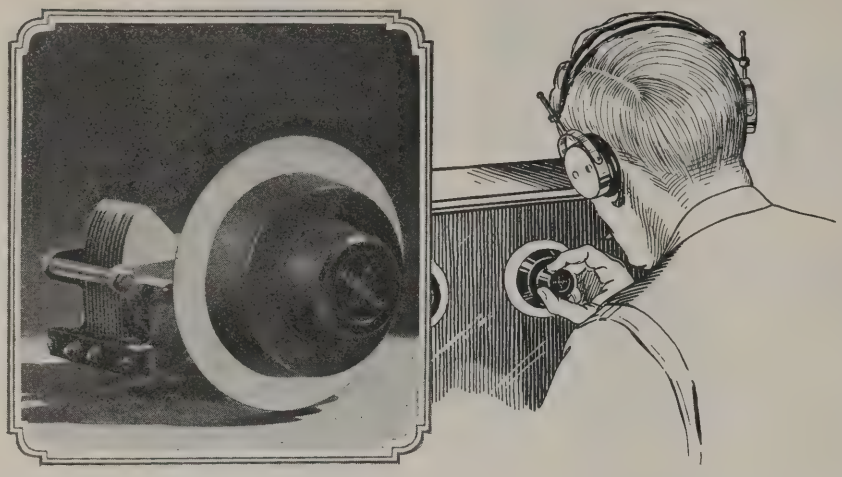

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Sound

(*Continued from page* 41)

ment house. A tremendous amount of energy is wasted in our task of accomplishing this. The number of changes or handlings of the coal undergoes in being transported to the apartment house is alarmingly large and each handling necessitates a large expenditure of energy in order to change it from one state to another. Thus far all our effort is spent in attempting to reduce the energy expenditure or waste to a minimum. If, however, a way could be found so as to eliminate the many changes or handlings and one scheme of transportation used then much effort would be saved.

The same thing holds in electricity and also in sound. In the case of electricity the greatest care is used in telephone and radio transmission to avoid changes in the electrical characteristics of the apparatus from point to point. Wherever changes occur, a loss in energy by reflection is certain to occur. This is why your loud speakers and phones have a high resistance in order that such resistance may equal or "match" that of the plate circuit of the tubes. It is also the reason why a transformer in a radio set is made with a definite number of turns in the primary and secondary windings.

In the case of sound passing along a pipe or through space care must be used in order to secure the transmission of the maximum amount of sound energy. In the accompanying figure if sound is passing along a pipe in the direction of A to B, more sound energy will be transmitted in case the internal diameter of the pipe is unchanged, as hown by the dotted lines, than is trans-

mitted if the diameter is suddenly increased at *c* and again decreased at *d*. At both *c* and *d* sound energy is reflected back toward A and less is transmitted to B. Reflection of sound energy again occurs at the open end, E, of the pipe and still less energy gets out into the surrounding space S. In a later article when we take up loud speakers we shall see how important these effects are in securing efficient and satisfactory horns for loud speaker use.

There are numerous other phenomena which we might describe to show the nature of sound, but it seems wise to include these in the next and succeeding articles. The present article may be summarized briefly somewhat as follows: Around us are material objects of every description immersed in an ocean of air. These objects are caused to shake or vibrate and set the surrounding air in a corresponding

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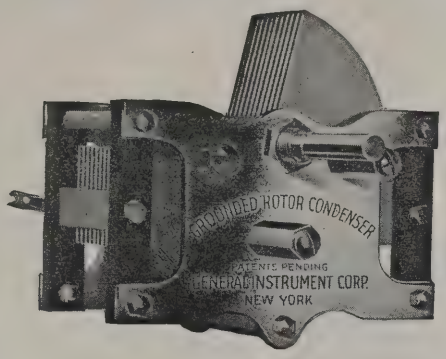

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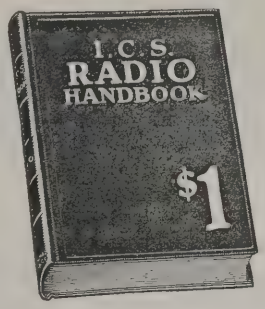

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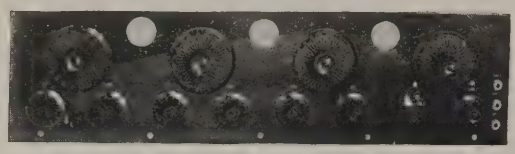

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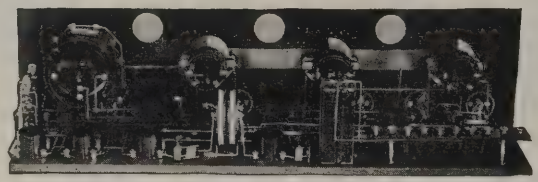

Illustration shows seven tube set. The Super-Unidyne may be built in five tube receiver for use with Western Electric Power Speaker, six or seven tubes with one or two stages audio, or eight tubes for one stage audio and two tube Push Pull Power Amplifier. Two stages Tuned Radio and one Stage Intermediate Radio used throughout.

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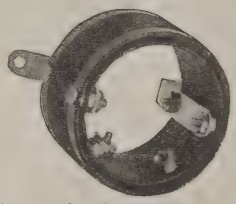

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UNIRADIO Tuned R. F. Transformers (not mounted at an angle) and Calibrated Intermediate R. F. Transformers have made the SUPER-UNIDYNE possible. No new or untried features are employed, every principle has been used by Radio Engineers throughout the country. A simple combination, thoroughly explained and easily understood puts the SUPER-UNIDYNE ahead of every other set of any type.

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Makers of

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state of agitation or motion. This constitutes sound. The ear, is merely a detector of sound which exists whether the ear is located in the right position to hear it or not. The air carries all these quivers simultaneously and because of long experience and association and their importance to us, we can identify and correctly interpret all of them.

As to some of the characteristics of sound, it has been shown how the air, other gases, solids and liquids are all conductors of sound while a vacuum is not a conductor of sound. We have also described sound absorption, reflection, transmission, and diffraction and shown how they enter in determining the quality of broadcast performances and home reception of radio. We described in some detail the analogy between electrical and acoustical energy, its transmission, the similarity between the electrical inductance capacity and resistance and the corresponding acoustical quantities, and finally, we described similar precautions which were necessary to take in order to transmit the maximum amount of both electrical and acoustical energy.

How I Made a Career

(*Continued from page 35*)

turing and demonstration of cooking is done at street corners!

But the crowning achievement was a radio cooking school and "radio teas." Nobody seemed to grasp the idea when I first proposed it; but it is a wonderful, standard institution in Chicago now. Think of it, women graduate from this school and secure diplomas, without ever stepping outside of their homes! They hear the lectures by radio and are examined by mail. Can you appreciate what this means to the host of women who wouldn't have time or money to take a school course?

And the "radio teas"! They are a joy to uncounted thousands of women. They may have a baby on their lap, or a dirty apron on, and be too tired to get up out of a chair, but they can "come to the radio tea" nevertheless! They can feel themselves in a group, and hear what other women have to say, and learn something, even though they are "tied to their jobs," as so many, many women must be. It had never occurred to me, but such radio talks and "teas" are an especial boon to the ambitious foreign woman who speaks English poorly.

Farm women, likewise, find radio an especial boon. Distance in her case keeps her from frequent communion with other housewives; keeps her from attending cooking or other women-subject lecturers. I believe the radio means a new era for women, an era of benefits only begun.

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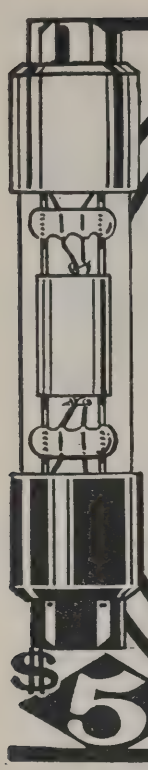

London Hawaii -Porto Rico

A Canadian amateur (T. A. Crowe, Calgary), operating on three Myers Tubes, heard the concert broadcasted by 2 L.O., London, England, and picked up Hawaii and Porto Rico the same evening. (Calgary Herald, April 1st). Are you getting results like this? You can with

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Prize Contest

(*Continued from page* 67)

favor them in the least.

Men who make their living by subscription selling have accepted my plan whole-heartedly, and have joined the staff on the basis outlined here.

One special feature deserves attention. To furnish an extra incentive, and to put a little sport into this plan, I have made a contest of the whole affair. This contest closes September 15th, and all who want to get in the running must do so at once. Later, I will arrange other contests, but this present one is the big event.

I am giving a Paragon RB2 $135.00 Receiver for first prize. This prize goes to the one who sends in the most subscriptions by September 15th.

For second prize, I am giving a Thompson Magnaphone $35.00 Loud Speaker to the one who sends in the next largest number of subscriptions by September 15th.

And the third prize is an N&K $8.50 Headset for the one who sends in the third largest number of subscriptions by September 15th.

The prizes will be given in *addition* to what you receive for the subscriptions. If you win a prize, your subscriptions will bring you cash or radio parts just the same. You are paid for your time even though you don't win a prize!

Put your photo in one of the frames and send it in—we want to see what you look like! But act promptly. Do it at once!

Burt Evans

—Boys' Editor.

Afloat and Ashore with the Operators

(*Continued from page* 55)

"Dear Sir:—

"I wish to thank you for giving me a line on one of 'That Old Gang of Mine'! Have not been in touch with Frank Rosenquist since he was up in Maine during the war. Frank and I used to build tuning coils about three feet long out of wire from old buzzers. Ask him about them.

"Just as a suggestion, would it not be possible to extend the scope of your articles to take in some of the old timers who have *left* the game but who will never be forgotten? It would prove most interesting. I most certainly would like a line on old ops, for instance, 'Don' Pieri, Dick Cuthbert, 'Red' Sutherland and 'Dusty' Rhoades.

"I am at a loss to know just exactly how to reach Frank so would ask that you forward these lines to him. Would like to hear from him and if he or any of the other old timers get out this way, there most certainly will be a place for them to hang up their hats and room for their feet under the 'mahogany.'

"Thanking you, I am,

"R. J. DEAN,

"Ex-operator, *SS. Montanan, Eocene, Prinz Jochim, Pennsylvanian, Texan, Mexican, Nebraska* and naval radio station Pt. Arguello."

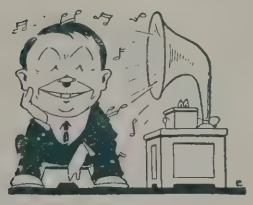
VOLUME 11

THE WIRELESS AGE

"America's Foremost Radio Magazine"

NUMBER 12

Radio on the River Styx



THE dreary, muggy waters of the River Styx flowed noiselessly past the Present on its way to Hope Eternal. Fate leaned on the helm apparently unconcerned as to the course.

Below, in the music room, several figures lounged around a radio set listening to the strains of Raggedy Ann. Closer inspection revealed their identity. Aristotle, Sophocles, Homer, Dante, Voltaire, Newton, Nietzsche and Rousseau. A queer party.

Jean Jacques Rousseau arose and addressed the gathering: "We did foregather here at the good counsel of Cleopatra, she being the master of this craft; save it having been, forsooth, the one she did own during the mortal days of her glorious reign; the purpose of this meeting being for naught else than to listen in on educational programs broadcast by our earthly brothers. And I am of the mind that each of us, having made history in our respective eras, shall learn of what avail to the world our lives have been. In this year of grace, 1924, the peoples of the world—the other world—should have come to know the lesson beyond price taught by ignorance."

At this point Cleopatra entered without troubling to open the door. Newton jumped to his feet and shouted: "I do wish you would not defy the laws of physical science by walking through a door without opening it!"

Aristotle glared at Newton. "Don't forget," he admonished, "you did upset a few of my theories in your time, for which I derive small solace."

Cleopatra smiled. "Well!" she exclaimed. "Emperors would fain quarrel over me for less than that; nor am I disturbed by such gross demonstrations."

Then, becoming serious, she proceeded with the business of the meeting. The educational development of the early Egyptian Dynasties was reviewed; the influence of priestcraft on the problems of abstract thought; and the multiplication of scribes and the accumulation of writings as a result of custom demanding records of affairs of state.

"Whereupon," she concluded, "more people today, know about my Obelisk—Cleopatra's Needle—than do those who would know aught of the library I built at Alexandria, or the records of great importance to civilization stored there."

Homer leaned forward. "True," he said. "Mortals, the adventures of Ulysses peruse; nor are they mindful of the philosophical teachings in the Odyssey."

Dante laid his hand on Homer's arm: "Ah, woe is me; nor am I read with comprehension lest such mortal turn from kind and custom, his weary way to seek amidst the unfrequented labyrinths of my blank verse."

Bacon laughed uproariously. "By my troth, Dante, Shakespeare has them sore puzzled to this day. Mayhap he had a few lions in the Sherwood forest and a clock in the period of the Merchant of Venice, but it did require the great wisdom of Goethe to understand Hamlet."

"There are many matters of which I am grossly ignorant," interrupted Cleopatra. "Tell me in good truth—did you write Shakespeare's works?"

"That, you will never know," Bacon replied. "The question, alone, has adroitly attracted students who might otherwise have never studied Shakespeare. I shall always leave that question open for the benefit of the mortal world."

SOPHOCLES, observing that Cleopatra was on the verge of practicing her artful wiles on Bacon in order to extract the desired information, anticipated another historical situation by taking possession of the floor. With characteristic directness he plunged into the subject of educational development following the decline of the Egyptian Empire. He dealt with the philosophical teachings of Greece, the commercialized schools of the Phoenicians, the militaristic tendency of the Roman educational system, and the moral trend of Christianity.

Jean Jacques Rousseau then dealt with the growth of formalism in the Middle Ages, and the economic conditions that led up to the French Revolution. Voltaire and Nietzsche elaborated the individualistic principles of Rousseau's teachings, treating with the transition period, and its effect on modern education. The sudden announcement in the loud speaker that the evening's educational program would commence, forestalled what promised to be a bitter controversy. The company hurriedly gathered around the radio to listen.

After the popular bed-time stories had been broadcast by Nick Carter, a talk on "Child Psychology," by Horatio Alger, Jr., was put on the air. This was followed with "Household Hints," by Laura Jean Libby. The "Musical Appreciation Course" was broadcast by direct wire from Coney Island. The next speaker before the microphone was the president of the Bucket Shop Exchange who delivered his weekly talk on "Safe Investments." A ten-minute lecture on "Political Economy" by the Soap-Boxer was followed by the "University Extension Course in Agriculture," broadcast through the courtesy of the Commission Brokers' Association. The big event of the evening was then put on the air. The second of a series of lectures on "Education" was delivered by the Society of Affiliated Flappers and Sheiks.

Sophocles rose, strode to the buffet, and grasping a cup, took a long draught of its contents.

"What are you drinking?" Voltaire asked.

"Bitter aloes," Sophocles answered. "On one occasion, in Athens, I did drink it for my nerves after I had sought vainly to prove that truth and understanding would be the reward to those who would but open their minds to knowledge. What we just heard on the radio is, forsooth, a confusion of what was actually broadcast. The confusion in the minds of those who listen in, but hear naught of what is truly broadcast save that which they might encompass without effort."

As one voice, the company spoke: "Pass the cup around, Sophocles. We'll all partake of this soothing brew!"

The Garden of Knowledge

A Twirl of the Dial Brings to Us the Wisdom of the Ages

Dr. Herman H. Horne, Professor of Philosophy, at New York University, sends this message to our readers: "Our American people are quite as ready for something solid as for entertainment. Some see in radio their one opportunity for university instruction. It is idealism, after all, that really grips the heart of humanity."

By WILLIAM A. HURD

RADIO has come to the individual as the one great medium for the dissemination of information and the consequent acquisition of knowledge. Should he fail to acquire knowledge it is mainly his own fault. Should society fail to exploit radio for spreading enlightenment then the fault lies somewhere between the individual and his social structure.

Archæological records have so far failed to disclose the origin of mammals. The first trace of these little fur-coated animals has been found near the close of the Reptile Age. Unlike the reptiles, which deserted their comparatively tender progeny at birth, the mammals cared for their young until such time that they had acquired the parental wisdom, born of experience, and handed down to the younger generation. Fully equipped, both mentally and physically, for the great struggle of existence, the young mammals stepped forth into the world prepared to compete with the massive creatures of that era.

In the later, but still dim shadows of antiquity, mankind trembled before the awful manifestation of natural forces. His was an existence of fear. But his, too, was the gift of reason. He had but to question and to him would come a knowledge of these phenomena. Mystery fled before reason. Elements were harnessed to do his bidding. And so it is that we approach a conscious evolution.

EDUCATION is conscious evolution. The voluntary acquisition of knowledge. But the acquisition of knowledge that we may put to some practical use. This, alone, has been effected largely by the natural economic circumstances, or conditions, of the land upon which any given peoples depend.

The early Egyptian civilization is an example. The silt left behind the flood waters of the Nile made Egypt an agricultural nation. Occasional droughts, however, forced the Egyptians to invent an irrigation system, which they did under the difficulty of scant engineering knowledge. This led to greater projects requiring a better engineering knowledge. They studied the stars, and subsequently founded a system of astronomy, all for the sole purpose of keeping a record of the seasonal changes that meant life or famine. And all this necessitated the keeping of records.

Skill in engineering and ease of transportation make for progress. The Nile stimulated the one, and made possible the other. Equality of sex was closely approached. Cultural development was natural. Art, the sciences, painting, and finally literature, were all steps toward a higher education. In the Sallier papyrus, the wise Dauf counseled his son: "Give thy heart to learning . . . for there is nothing so precious as learning." But the purpose of learning was practical. The search for truth for its own sake was considered a waste of good time. And because of this the religion of the early Egyptians lacked any degree of morality. The subsequent decline of the Egyptian Empire was in a large sense due to this lack of moral fiber in their cultural development and educational growth.

"The Man in the Moon" and other bedtime stories evidently delight the young and this picture ought to delight the story-tellers

THE Oriental peoples had begun to control nature, but were opposed to the development of the individual. Class distinctions further hampered their natural progress.

Education was developed to the point of present day elementary and higher school training, but the latter was mainly reserved for the priesthood. The method in educational training was not initiative, but neither was it genuinely rational. The individual had little freedom. He was in bondage to the past.

Individual freedom be-

The modern educational system. Radio now plays an important part in extending the facilities of the foremost universities

gan among the Jews, Greeks and Romans. These peoples had ideals and considered the future. Individualism became a fact. But not universal. It remained for Christianity to make individualism universal. This was accomplished through the Christian tenets which recognized the brotherhood of man, gave to women and children their rights, and demanded a high standard of morality.

Following the corrupt and immoral vices of the Romans, who knew no other virtue than civic, the Christians' religion made a universal appeal because of its equitable tenets to all men. The religion itself served as an education. In fact, the early Christian catechumenal schools, which prepared the would-be converts for entrance to the church, were the forerunners of the parish schools of today.

THE keynote of education in the Middle Ages was authority and repression. The Renaissance, the period of awakening, degenerated to a level approximating Ciceronianism. Then followed the Reformation period in which religious and theological awakening played an important rôle. The reaction to this was formalism, and the back swing of the pendulum resulted in the search for real things. Realism was the beginning of our modern scientific movement.

Religious and political growth soon developed into Puritanism and Rationalism. But this, too, became formal, hard, and eventually underwent a change. It was the perfect setting for the complete reaction that came with the teachings of the Swiss-French philosopher, Jean Jacques Rousseau. Thus was the way prepared for the French Revolution.

Out of the ruins grew modern civilization, the balanced educational growth that stresses the interdependence of the individual and society.

Shakespeare summarized the situation at that time with this: "There is no darkness but ignorance."

WE must know the educational aim of any period to estimate the development of that period. We must know its content, the method, the organization designed for its execution, and finally the results.

The attitude of the eighteenth century was certainly destructive. But the social development, the psychological effects, and the scientific progress of modern times has been built on the ruins of that experience.

The present tendencies in education should test the relation of the individual to society. The value of his activities is measured largely by his ability to harmonize with society. The interests of both are mutual.

The study of the child's development was indirectly started by Rousseau. He, and to a large extent, Pestalozzi, tried to reach the child through a sympathetic insight into the activities of the child. This educational process later found its justification with Herbart and Froebel in the underlying basis of psychology. Rousseau was concerned with the rearing of individuals separated from other individuals. This was essentially an unsocial, narrow perspective. Herbart, in direct contrast to this selfish attitude, was concerned with application of popular instruction and upon the development of moral character.

In this you have the fundamental underlying the bedtime stories broadcast to children. It will be well worth your while to secure the "History of Education," by Frank

Pierrepont Graves, from the library. Read that pulsating volume and then tune in again on the bed-time stories. Watch your child as he listens.

ABRAHAM LINCOLN said that education is the most important work in which we as a people can be engaged. The broadcast stations of the country are engaged in this work. The various educational programs radioed to you, at your fireside, are packed with popular interest. They must be to hold the listener in.

Once you have caught the really human interest thread that cunningly weaves through broadcast educational programs you will have acquired a new means of diversion quite suited to your taste.

Even daddy is amused at the wonderful influence radio entertainment has upon the child mind

Bacon held that some men, like the spider, spin all their knowledge out of themselves; some collect it indiscriminately like the ant; while others gather facts wherever they can find them, and from these facts bring forth new products by means of their own thoughtful elaboration. This classification may be applied to those who use radio for what they can obtain in an educational sense.

BROADCAST stations across the country put on the air many varied programs of an educational character. Educational in content but entertaining in mode.

New York University broadcasts a series of talks, or chats, if you like, on subjects to do with philosophy of life, modern public problems and systematic psychology. Their program for this Fall will include biology, economics, anthropology and ethnology, and many other studies of general interest. Each, however, will be framed and presented with the view to attracting those who would have them in an understandable, popular vein. The courses are based on the work offered in the University. It has been demonstrated that students get but little from a course composed solely of lectures. Some outside work, or collateral reading, must be done if the listener wishes to get the most value out of his study. New York University will supplement their programs with reading matter designed for the radio listener.

Likewise Columbia University furnishes their radio audience with supplementary reading which aids, materially, the educational courses broadcast by the University Extension Department.

The University of Pittsburgh, Antioch College, Cornell, The Queen's University at Kingston, Ontario, the State College of Washington, Kansas State Agricultural College, Georgia School of Technology, North Dakota Agricultural College, and a host of other universities, colleges and high schools, broadcast educational programs. The versatility displayed in their programs is remarkable. Their grasp of the radio mind is nothing short of ingenious.

Turn to the Broadcast Station Directory in this issue and count the number of educational institutions operating radio broadcast stations. The number totals to about seventy. That directory can be of service to those who will use it.

HERBERT SPENCER in his book "Education," first decides what constitutes real knowledge, and then deals with the subject of education as intellectual, moral and physical development. In one section of the book, he says:

"The men to whom, in boyhood, information came in

"The time is not far distant when, in every city, at least one high school will be radio equipped and utilization made to broadcast instruction in high school subjects. Registration in regular classes will be undertaken by mail and credit given following tests and examinations suitably passed. This will give thousands who work in daylight hours a chance at more and better education. Mathematics, English, Economics, Science, History and Languages can be taught successfully by this method. An inexpensive receiving set will be the only expense. The city will loan free of charge the required text books.

"Today the use of radio is confined almost solely to entertainment. Tomorrow people will come to see and use its possibilities for education."

—F. G. KENNEDY,
Principal, North Central High School, Spokane, Wash.

Sigmund Spaeth, Ph.D., is internationally known as an authority on music. An experienced writer, he has written many common sense articles on music; to the readers of this magazine he says: "I want people to realize that if they respond to any kind of music in any way, even if it is no more than 'keeping time when the band goes by,' that response can be developed into something really worth while. I want them to realize that their love of a good tune is nothing to be ashamed of, and that any lasting appreciation of music must be founded upon that sincerity which responds to fairly simple and obvious rhythms and melodies—so I am glad to give full credit to the radio for its help in popularizing good music."

—SIGMUND SPAETH, Ph.D.

"There is a great deal of evidence to indicate that the motion picture industry consciously appeals to the unthinking. In so far as this is true, motion pictures cannot be truly educational. So far it has appeared that radio broadcasting has made a somewhat similar appeal in many instances, although it has not gone as far, perhaps, as motion pictures have in this direction.

"In my opinion, the educational effects of radio will depend primarily upon the type of mind to which radio programs are designed to appeal. I feel that the same fundamental principle applies here as applies to newspapers, magazines, and motion pictures."

—F. D. FARRELL,
Dean and Director, Kansas State Agricultural College.

"The newspaper, the telegraph, and the telephone have added their bits toward increasing the scope of education and international good-will. Every means of communicating intelligence is bound to further the intellectual standing of the masses. Radio appears to be more prolific in its possibilities along these lines than any one of the others. It not only adds a method of point to point communication, but it also has a broadcasting power rivaling that of the press."

—C. S. PERKINS,
Instructor, Massachusetts Radio and Telegraph School.

"Not since the invention of the printing press wrought its wonderful change in the common education of the Middle Ages, has there been any agency so fraught with possiblity in the cause of public enlightenment as radio. It is one of my pet thoughts that a century hence when some historian writes radio into the story of the world's progress, its overshadowing feature in the review of Time will be that it contributed a new standard of mass education to our great turmoil of humanity."

—GUY E. ENTWISTLE,
President, Massachusetts Radio Institute.

"To my mind radio forms the most fascinating field in the realms of science. It is considered of such educational value that schools and colleges throughout the entire country are equipped with radio transmitting and receiving sets. It should, and will be a part of every man's education for it teaches some of the most valuable fundamental principles of electricity and it must be realized that electricity is the greatest force in the world today."

—J. A. DOWIE,
Chief Instructor, National Radio Institute, Washington, D. C.

dreary tasks along with threats of punishment, and who were never led into habits of independent inquiry, are unlikely to be students in after years; while those to whom it came in the natural form, at the proper times, and who remember its facts as not only interesting in themselves, but as occasions of a long series of gratifying successes, are likely to continue through life that self-instruction commenced in youth."

In that passage Herbert Spencer has touched the keynote of many complexes nursed in the hidden recesses of our sub-conscious minds: the complex resulting from forced issues in the matter of good reading, or perhaps the attempt to cultivate in the child a taste for good music. How many of us have come to view with apprehension the mere thought of reading the Scriptures because there are those of us who were forced at a tender age to read its contents, not for the action and the images there presented, but rather for the abstract morality contained therein which is so difficult for the immature mind to grasp. Thus was a complex registered in the subconscious mind that later becomes distorted as adult reason attempts to side-step the early impression.

COLUMBIA UNIVERSITY broadcasts a brief course in the Old Testament calculated to arouse interest and stimulate reference to certain passages in the Bible. The method is unique. The listener is asked to sit around the camp fires of Syria while the Fathers tell again the thrilling accounts of human sacrifice, and of Abraham's leadership; of the turning from the freedom of the deserts to the cramped existence in Egyptian cities, and the later glories of King Solomon's Reign. Such is an example of what radio brings to us.

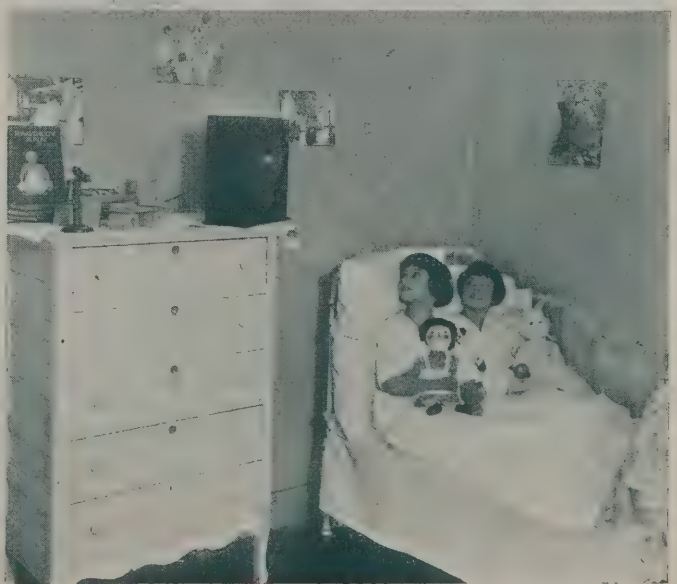
How many of us have suffered the torments of dress regalia to sit through a music recital unable to grasp the true significance of what we genuinely wished to understand. Perhaps there are those of us who in childhood days were backed into a corner and the lesson of good music—classical music—was drilled into our rebellious minds under the terrifying proximity of a dictatorial finger. Such vain-glorious efforts to reach the sub-strata of plebeian tastes unaccountably present in youth somehow fails to penetrate the stubborn resistance of a young mind. A later-day complex is inevitable.

Music appreciation courses are broadcast for just such reasons: the education of the musically-inclined by gradual initiation into the erstwhile mysteries of orchestration. The knowledge gained by radio, supplemented with a small amount of reading, will open new fields of interest to us, particularly when we listen in on symphony programs broadcast by the Philharmonic Societies and the leading theaters. Broadcast music can bring to us the creative genius of great masters, but it remains for us to interpret the pictures devised by these great composers.

THE garden of knowledge, in a broadcast sense, is a garden of wonders. A twirl of the dial brings to us the wisdom of the ages. The history and knowledge of subjects ordinarily beyond our grasp come to us by radio. Science has none of the academic or prosaic that somehow lingers with the memory of blackboards, and the tired, care-worn figure of a teacher. Literature comes to us fresh, invigorating. This by radio.

As we roam the airways that lead to the garden of knowledge it is once again playtime—we play and learn.

Radio helps you in doing your "daily dozen"



And last, but not least, radio sings 'em to sweet sleep

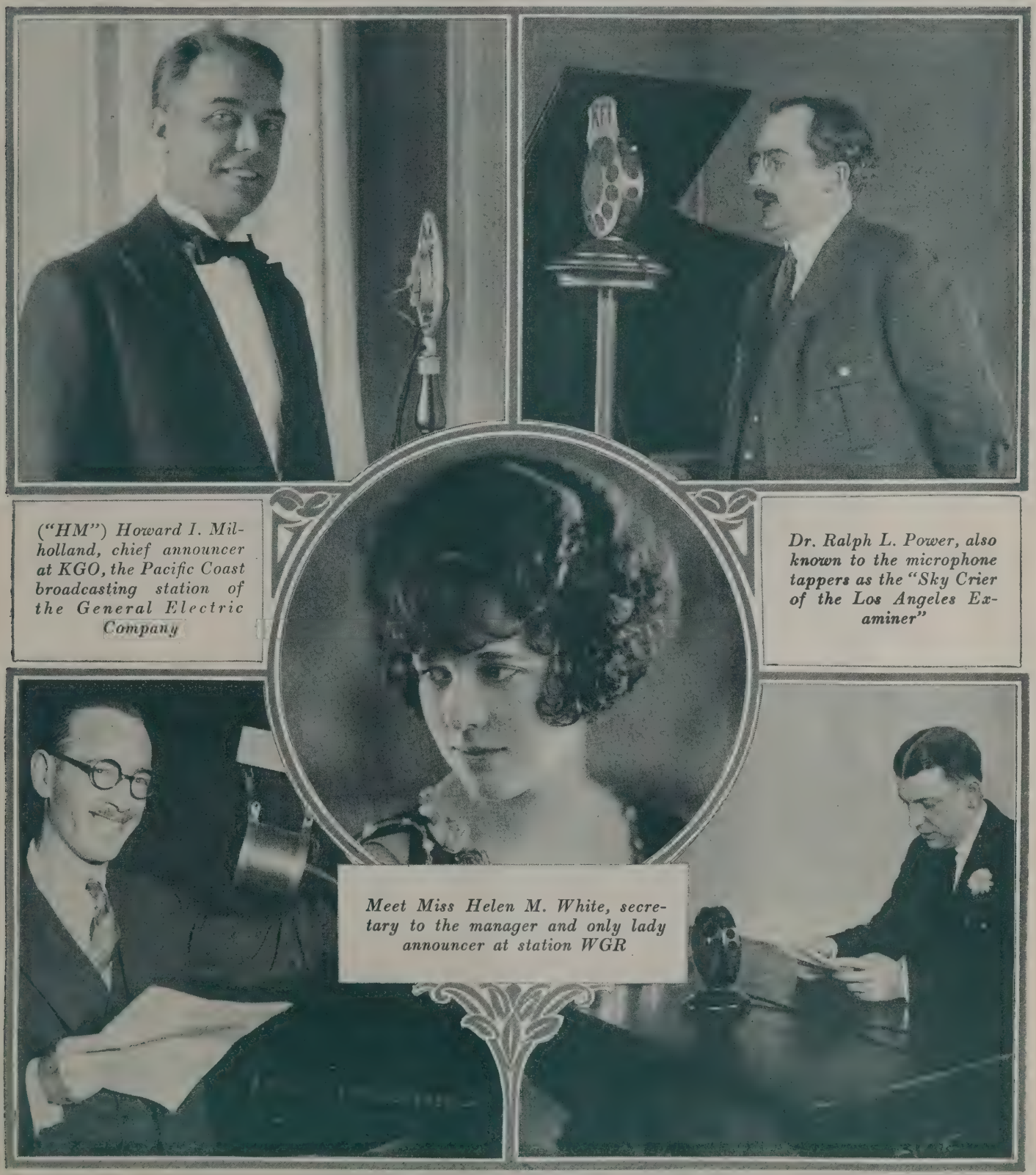
Broadcast Artists

Margurite Quimby, of Cleveland, as she appeared before the microphone

Hon. Wendell Phillyss Dodge, author and playwright, appeared at WOR

Clyde Agnew Criswell, author of the popular radio play "The Secret Wave"

Miss Ruth Arden, soloist with the Kudisch Ensemble—WJZ

Voices You Hear Nightly

("HM") Howard I. Milholland, chief announcer at KGO, the Pacific Coast broadcasting station of the General Electric Company

Dr. Ralph L. Power, also known to the microphone tappers as the "Sky Crier of the Los Angeles Examiner"

Meet Miss Helen M. White, secretary to the manager and only lady announcer at station WGR

Edward Borroff, chief announcer at the Westinghouse station KYW, Chicago. His voice has probably reached all sections of the country

Wm. Holliday, program manager of WWJ—The Detroit News. Broadcast listeners are probably more familiar with his novel programs than with his dignified appearance

A Herdsboy ASCENDS SCIENTIFIC HEIGHTS

From Idvor to Castle Garden and through the institutes of learning in Hungary, Berlin, Vienna, Cambridge and Columbia the herdsboy emerges as university professor, research engineer, inventor and the far famed scientist—Prof. M. I. Pupin

By STUART HYDE HAWKINS

IF you should by chance thumb over the pages of the 1924 volume of "Who's Who in America," and should glance at a point about halfway down one of the right-hand columns in the "P" division, you would find the following terse paragraph:

PUPIN, Michael Idvorsky, University Professor. b. Idvor, Banat, Hungary, October 4, 1858; s. Constantine and Olympiada P.; A.B. Columbia, 1883; Ph.D. Univ. of Berlin, 1889; (Sc.D. Columbia, 1904; LL.D. Johns Hopkins Univ.). Married at London, England, Sarah Katherine Jackson of N. Y. (now deceased); Asst. Teacher Elec. Eng. 1889-90, Inst. Math. Physics 1890-92, Adj. Prof. Mechanics 1892-1901, Prof. Electro-Mechanics since 1901, Columbia. Fellow A. A. A. S., N. Y. Acad. Sciences; mem. Nat. Acad. Sciences, Am. Philos. Soc., Am. Physical Soc., Am. Math. Soc., Am. Inst., Elec. Engineers. Address, The Dakota, 1 West 72nd St., N. Y. City.

Since there is little hint of unusual interest or romance in the skeleton biography, you would in all probability continue to thumb over the following pages until you reached the appendix and closed the fat red volume. Which would be a grave mistake—you should have closed the volume immediately after reading the Pupin sketch, and turned to the biggest and most complete atlas obtainable, for surely "Idvor, Banat, Hungary," has an intriguing sound.

But, unless you had a pre-war atlas, and a very large one at that, "Idvor" would be among the missing places. So, to save you exasperation and trouble, I shall tell you what I found when I decided to see what actually lies behind the array of collegiate titles won by this "university professor." And in advance let me say that the story which I unearthed is worth far more trouble than I had to go to in getting it, for it is such a story as our greatest authors could not render more fascinating, more inspiring, with all their pretty phrases and word-pictures.

First, to find Idvor. On most maps it is non-existent, and on the large-scale detailed ones it is but the veriest shadow of a dot, for it is almost infinitesimal in size. And yet in splendor of history and glory of tradition it is gigantic, and in its history lies the key to the career of Michael Idvorsky Pupin. There is romance in the story of his life, and there is romance in the story of Idvor; there is a splendid independence in the history of Idvor, and a splendid independence is one of the outstanding characteristics of this man of Idvor.

Centuries ago, when the fear of Turkish invasions sat upon all southern Europe like a pall, the emperor of Hungary invited a community of Serbs, noted for their courage and their strength, to leave their native valley and live upon the southeastern border of his empire, promising them complete and perpetual independence in return for the preservation of the Hungarian domain against Turkish inroads. To those Serbs, independence was the most cherished of all mortal possessions, and they moved—whole villages of them—to the flat borderland, where they settled down to their business of agriculture and war. For generation after generation they formed the wall against which the ever-recurring waves of Turkish armies dashed and spent themselves in vain; and the little village of Idvor was the center of many and many a barbarous struggle. It is even today a point of pride among the people of Idvor that not once did the Turks succeed in breaking through, and the little Idvorians still listen wide-eyed and breathless as the old men relate the sagas of those unconquerable ancestors who fought so fiercely and so successfully that they might have perpetual independence.

Rich in glorious tradition is the history of the men of Idvor, and when Michael Pupin was a tiny youngster that history was not to be found in books, but was told and retold by the elders of the village as they sat in solemn social congress before the blazing logs on cold winter nights. By the time he was six he knew the tales by heart, and thrilled with pride that he was an Idvorian—a descendant of the fighting heroes of old. Tradition is the best of preceptors, and the love of independence flourished within the lad as it had within his forbears.

Neither of Michael's parents could read or write, and at first the attendance at the village school irked the athletic lad beyond measure, until his mother gave him an insight into the wonders of the world to which the written word is the key. From then on he absorbed the teachings of the village schoolmaster eagerly.

The Pupin coil made possible transcontinental wire telephony. It is termed a toroidal telephone repeater coil and is wound around a soft iron core, the whole unit being inclosed in an iron weather shed for protection against moisture and the elements

As a youngster he learned, unwittingly, a principle which has but recently—since the invention of radio—become generally known. During the summer months the boys of Idvor were sent out as herdsmen, watching over the oxen of the village; because of the heat of the day, the animals did most of their grazing by night, and marauding cattle-thieves were constantly waiting to drive any wanderers from the herd, so that some method of keeping guard other than by vision was imperative during the Stygian nights. The boys used to stick their long-bladed knives into the ground, lying with one ear pressed against the handle; for they found that the sound of the grazing oxen came far more clearly through the medium of the ground than it did through the air, and with the knife-blade as detector the boy, lying quietly on the edge of the pasture, could locate a straying ox through his hoof-beats at a considerable distance.

During the long summer nights and the warm days questions arose in Michael's mind which he was unable to answer; questions as to the nature of light, heat, and sound, which the humble Serbs defined as divine creations that could not be explained. And while he was striving to answer the "What is it?" of his mind, news reached Idvor of an experiment made by an American, one Benjamin Franklin, with a kite and key during a thunder storm; the schoolmaster explained Franklin's theory to the eager youth, and the boy's father chided him for heresy when he related the story at home. Again his mother stepped in on behalf of education, and her son was allowed to continue his studies. Shortly thereafter young Michael outgrew the school at Idvor, and attended the more advanced school in the village of Panchevo, fifteen miles down the river from Idvor. There he found an answer to his question as to the nature of sound, for Kos, the schoolmaster, could and did explain the transmission of sound by vibration. In the playing of the bagpipes by the village piper young Pupin found verification of the explanation, and the tunes of the bagpipes became indelibly associated in his mind with the nature of sound. To his queries about light, however, Kos was unable to answer.

Prof. M. I. Pupin, dean of radio engineers, and professor of electro-mechanics at Columbia University since 1901

At that time word reached the villages of the greatness of Abraham Lincoln, the American Liberator, and Michael heard his father call Lincoln the "American Kara George"—and was not Kara George almost a god to the tradition-loving Serbs? America became a very nice place indeed to the growing boy, for did not Benjamin Franklin and Abraham Lincoln both live there, and were they not both great heroes?

Shortly afterward—in 1872—Michael became embroiled in a demonstration which took him away from the quiet little village; the emperor of Austria-Hungary, since there was no longer any danger from invasion, abrogated the pledge of independence to the frontier-Serbs, declaring them subjects of the empire, and the spirit of revolt smoldered hotly in Idvor and Panchevo. A school-boy parade found Michael carrying a banner which was decidedly not complimentary to the emperor, and he uttered many cries of a decidedly independent nature as he marched. In consequence Kos, the schoolmaster, persuaded the parental Pupins to allow the lad to leave the vicinity, and go to school at Prague. Since the boy was already as far advanced as was his teacher and since it was almost imperative that he should not attract the attention of the authorities until their suspicions as to his loyalty to the emperor be quieted, young Michael, then fourteen years of age, said goodby to his parents for the first time and sailed down the river bound for the "great school" at Prague.

On the boat he met several older students, who treated him most considerately and stole his food; an incident which so firmly impressed the necessity of constant watchfulness upon the lad that he never afterward forgot it. Having stayed awake from excitement all night that he might not be carried beyond the proper landing, he went to sleep just before arriving there and was carried to Vienna. Alone in the vast city—the first he had ever seen—with no idea of how to get to Prague, he was approached by an American couple, who took him under their protection and transported him to his destination. Again the greatness of America was impressed upon the boy.

At Prague he found an even hotter bed of revolutionists

than at Panchevo, and was soon one of them; his studies suffered somewhat because of his radical tendencies, and when his father died the next year he knew that he could not remain there and allow his mother to pay his tuition when he took no interest in the work he was expected to do. Consequently he sold all his belongings, scraping together enough money to buy a steerage passage to America, and on March 12th, 1874, the sixteen-year-old boy sailed from Hamburg on the *Westphalia,* having written his mother a glowing account of the brilliant future which awaited him in the new country.

Professor Pupin describes himself upon his arrival at Castle Garden as "the Serbian greenhorn," for he could not speak a word of English, and had no idea of what he was to do. His first two experiences in New York were blessings in disguise, for they did much to fit him for life in the new land. As he walked across the Battery, with his bright red fez on his head, a group of newsboys spied him and marked him as their prey. One of them, when the newcomer showed no appreciation of the shouted insults—he had not the faintest idea of what they were saying—walked over and knocked the fez to the ground. Michael understood that language, and jumped upon the boy with all the fire and strength which the long summers of rough-and-tumble with the other herdsboys had given him. To his amazement, the rest of the newsboys did not aid their comrade, but formed a circle and watched the fight with interest. When the newsy was defeated and the insult avenged Michael arose and continued on his way, with the cheers of the others following him. Certainly fair play was a prime virtue in America, he decided, and felt a strong liking for the country to which he had just come. A little farther on he passed an old woman selling pies, and, being somewhat hungry after the excitement and exertion, spent almost his last coins on a luscious-looking prune pie. Strange to relate, the pie was full of prune-pits instead of prunes, and the little Serb realized all too keenly that he was still very much of a greenhorn.

OUR best authors with all their art could not render a story more fascinating or inspiring than this true life story of Prof. M. I. Pupin.

By the simple expedient of sitting quietly in the Immigrant Employment Office at Castle Garden, he found a job—for a Delaware farmer, who spoke Serbian, took him to Delaware as a mule-driver. There Michael learned to speak English, and the rapidity with which he picked it up, and the meticulous care he took to lose the foreign accent, gained him the praise of "a smart boy" from his kindliest tutor, the farmer's daughter. That winter he returned to New York, and managed to pick up enough money to keep himself alive by painting signs—a profession which only the law of supply and demand qualified him to fill. Having been brought up in an agricultural country, he naturally gravitated to the farm again the next summer, this time being employed on a farm in Saint Mary's, Maryland. As soon as the season was finished, he headed for New York, walking through Philadelphia en route. After one day in the quiet town he decided that he could not emulate the career of Benjamin Franklin no matter how long he stayed there, and started walking north to Manhattan again. He passed through Princeton, and became imbued with the desire to attend the college—the dignity and beauty of Nassau Hall impressing him with a deep and abiding sense of reverence.

Back in New York, he secured a position in a cracker factory—and met Jim. Jim was the engineer of the factory; a man of little education, but boundless in common-sense, who did much in stimulating the "Serbian greenhorn's" interest in science and study. There in the engine-and-boiler room of the cracker factory Pupin made his first studies of the nature of heat, augmenting his observations by reading the *Scientific American* and the scientific section of the *New York Sun.* Jim helped him tremendously, expressing in his own words the truths which the lad found couched in scientific terminology, and as the "What is it?" of his childhood was answered Michael found a multitude of more detailed questions to puzzle over. To Jim belongs the credit of removing the last trace of greenness in the boy's consciousness, for the old engineer explained the history of the United States in such a way that the boy grasped the similarity between the young American traditions and the ancient Idvorian ones—and the new country felt warm and homelike at last.

Through his interest in the history of the country came his decision to attend Columbia University instead of Princeton, for it seemed to him that many of the heroes of the United States were Columbia graduates, and surely the university must be a splendid one to have produced such men as Alexander Hamilton. And forthwith he settled down in earnest to pass the entrance examinations.

The college career of Michael Idvorsky Pupin sounds more like a fairy tale than a fact, for it is almost inconceivable that a raw youth who had arrived in this country, unable to speak a word of the language, only four years before, could accomplish what he accomplished. The cold conciseness of the "Who's Who" biography gives no inkling of all that that period meant to the young man, and it is more than probable that he himself had no realization of the magnitude of his achievement. In 1879 he passed the entrance examinations to Columbia with such high marks that he was not required to pay tuition for the first year, and the "Serbian greenhorn" had become a university student. He worked his his way through by winning scholarships, by tutoring the more affluent but less brilliant classmates, and by sawing wood during vacations. And in his junior year he was elected class president—this man who eight years before had been set upon by a gang of newsboys!

He received his citizenship papers and his diploma within twenty-four hours of each other, in 1883—and with his diploma came a three years' scholarship enabling him to go to Cambridge, England, in further pursuit of the answers to his insatiable "What is it?" England was the home of Faraday and Maxwell—and those two names were the outstanding ones in the world of electrical engineering at that time—so Michael Pupin hied himself to England. At Kings College in Cambridge he found the satisfactory answer to his question "What is heat?" and "What is light?"; during vacation he visited France, and visited his mother in Idvor. Back again—driven by the ever present urge to find out for himself—the truths of the scientific world—to Cambridge, where he met the famous Tyndall and cleared away his last questionings as to the nature of light; then to the University of Berlin, to study under Helmholtz, the foremost electrical experimenter and authority of that day. While there he learned the explanation of the Hertzian oscillator—the grandaddy of radio—and with Helmholtz's aid satisfied himself as to Faraday's theories.

While on vacation he met his future wife, and at once headed for New York to find some sort of a position. A month later he returned to London, though he had ac-

cepted the offer to be "teacher of mathematical physics in the department of electrical engineering" at Columbia, and married Sarah Katherine Jackson, the sister of a classmate of his. After one more year at the university of Berlin he received his Ph.D. and returned to New York and the position at Columbia.

There occurred the second great metamorphosis in the life of this one-time herdsboy; the "university student" became the "university professor," who was shortly to gain international fame for his research work and his inventions.

As an educator and instructor, Professor Pupin holds high rank in collegiate circles today; but it is upon his activities in electrical research that I am going to touch, for it is there that we find the ever present "What is it?" of Michael Pupin, and can see the independent Idvorian youth finding out for himself.

A young college professor who is teaching classes in three different subjects does not have much time for research work, and until 1890 or so Instructor Pupin had little opportunity to experiment with the meager equipment which at that time was accorded the electrical engineering department. As soon as he could, however, he commenced evening research work, experimenting with the passage of electricity through various gasses at low pressures—the first approach to vacuum tubes. He published two papers on this work, but found that Professor J. J. Thompson of Cambridge had anticipated and bettered that very work, so he—being, as I have said before, most independent by nature—turned to something else. The something else was a very worthwhile something.

Prof. Pupin receiving the Medal of Honor from the Institute of Radio Engineers for his research work in radio. Major E. H. Armstrong and Prof. J. H. Morecroft, president of I.R.E. presented the medal

While at the University of Berlin, Pupin had been much interested in Helmholtz's acoustical resonators with which the professor proved his "harmonics" principle of sound transmission; and the young instructor built electrical resonators, employing the same dynamic principles as the ones employed by Helmholtz, for investigating the Rowland distortions in electric current. These resulted in the discovery of the electrical "harmonics"—and Pupin, remembering the bagpipes of his boyhood, called the manipulation of his apparatus "tuning." You use the principle which Pupin first employed and named, every time you listen in on your radio receiving set. He patented his invention, and in 1908 sold it to a representative of the Marconi Company. Thus was made possible the first receiving set.

In 1895 the discovery of the X-ray by Roentgen was announced, and through Pupin's familiarity with vacuum tube research he was able to make the first X-ray photograph in this country. He employed a fluorescent screen, thus shortening the time required to make the photograph by almost sixty per cent. By this time the name of Pupin had become one of note throughout the scientific world.

It is for his greatest invention—the invention which bears his name, the Pupin coil—that the whole world knows Professor Pupin, however; for without that invention you could not telephone from New York to Boston for five times the rate you now pay. The Pupin coil—the coil which makes long-distance transmission of sound over wire possible—is the direct result of that persistent "What is sound?" which so worried him as a boy. Through his grasp of the nature of sound, he was able to apply to the electrical current the same physical characteristics which cover vibration of a string—and the Pupin coil is the result. The American Telephone and Telegraph Company bought his invention, and has found nothing to supersede it for efficient transmission of long-distance conversations.

Prof. Pupin was at one time director of the research laboratory at Columbia University and is an ex-president of the Institute of Radio Engineers. Under him at Columbia University such men as Dr. Alfred N. Goldsmith, Major E. H. Armstrong, inventor of the regenerative, super-regenerative and super-heterodyne circuits in radio, Prof. J. H. Morecroft and others have studied and furnishes the reason for the title "Dean of Radio Engineers."

His duties as university professor did not prevent him from developing his inventions, for he has worked extensively in the practical adaptation of his inventions in connection with the telegraph and telephone. Many of his improvements are known by his name throughout the world.

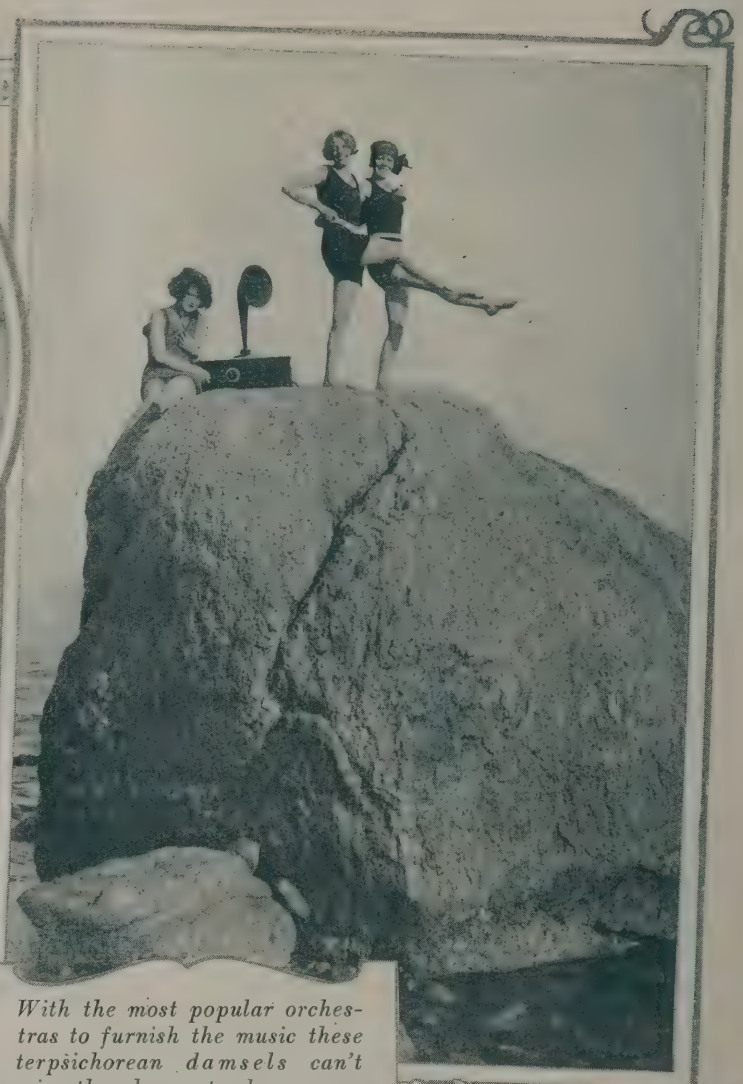
In view of the wonderful achievements of Prof. Pupin there is hardly a gathering or meeting of scientific men for purposes of discussing new developments especially in the field of radio, but what his presence is desired and his opinions are sought. He is a pleasant, versatile and authoritative speaker having as a background an experience unusual to most men upon which he can draw to make clear his thoughts and at times afford the entertaining touch so necessary to attract his audience.

The modesty of Professor Pupin with reference to his achievements was strikingly illustrated on the occasion of one of his lectures on the toroidal coil and its mysteries which we were fortunate enough to attend. The Pupin coil and many of his other inventions had already been developed and used extensively in the business of the world and were adding to his widespread fame, so we knew it as the famous "Pupin Coil." Irrespective of this, not once in the course of the lecture was it referred to in that manner—not once did he hint that he was the man who had given it to the world.

So we shall leave him—this independent son of Idvor, whose work has resulted in the convenience of the telephone and of the radio—whose name today looms large in the world of electrical science. We shall leave him answering the "What is it?" of the Columbia students, and asking himself the same question concerning phenomena which most of us have seldom if ever heard about. Michael Idvorsky Pupin, the "Serbian greenhorn," student, professor and inventor!

Women in Radio

Miss Mimi Palmeri, the beautiful star in "Ragged Edge" takes a dip and listens in



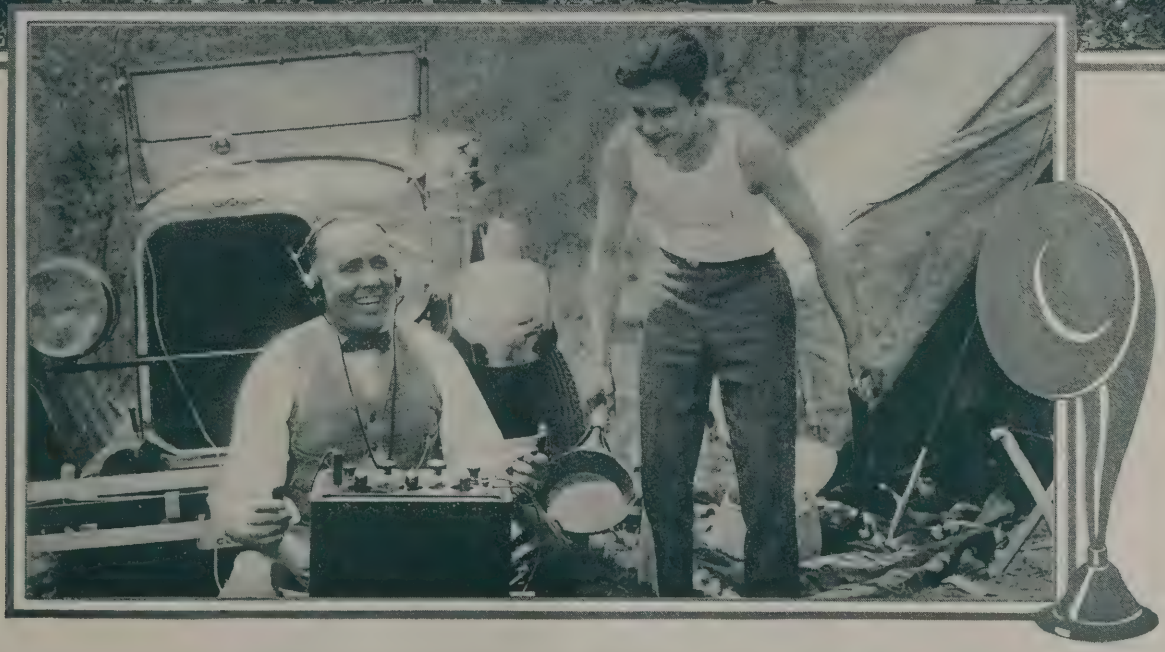
With the most popular orchestras to furnish the music these terpsichorean damsels can't miss the chance to dance even though the floor is "terrible"

Vacationists this year took their radio sets along and were suprised at the pleasure it afforded them—and some of the ladies did their own installing.

New York society finds pleasure in "listening in" to radio broadcasting while enjoying afternoon tea

Radio in the Great Out-Doors

Radio helps to bring civilization back to nature in the great wild woods where the young find freedom and pleasure



The roadside picnic for auto parties is enhanced considerably by the presence of a portable set and loud speaker

Carefree and young again, Bob Mulford—the famous automobile race driver—listens in to broadcast programs during one of his camping tours

The Second Shot?

There was a loud crack in the horn, like a pistol shot! —just one—and then the mysterious Dunellin case was tried a hundred times over, in the newspapers, on street corners, in homes, clubs and offices

By GARRET SMITH

THE mysterious killing of Andrew Dunellin, leading citizen of Flowerville, was a tragic anti-climax to the celebration of the hundredth anniversary of that city.

Dunellin, as master of ceremonies, had been his most triumphantly flamboyant self on that final evening of the carnival week and of his own life. The great mass meeting which closed the event had turned into a personal tribute to him. Prof. Mayhew, of the History Department of the State University, who had come to give an historical sketch of this pioneer community of the commonwealth, struck the keynote in his complimentary references to the city's most progressive citizen. Senator Nefus reiterated it. When Andrew Dunellin himself threw the meeting open to general discussion of building a permanent memorial, the adulation reached its height.

The 3,000 citizens who thronged the Grand Theater gave him thunderous applause. This approval was echoed, in thought at least, by the majority of the 100,000 more who listened to the proceedings before the bellowing mouths of radio horns in all parts of the city. It seemed as if Dunellin had successfully oiled the waves of opposition that had at one time threatened to disturb his career.

At the close of the meeting he gave an impromptu reception in his box to prominent citizens, friends and newspaper men, who crowded in to shake his hand. In his hearty friendliness to all comers there was no hint of secret fear. When he and his immediate party started out of the theater the last of the crowd had departed. Old Mike Hartigan, assistant janitor, a little the worse for liquor as usual, lingered suggestively near the entrance, waiting to lock up. The only other person in sight was Martin Lewis who stopped them in the lobby.

"Pardon me, Mr. Dunellin," he said, with nervous abruptness. "May I see you upstairs a moment? We ought to phone a little final statement to the papers, giving the total pledges on the memorial."

Lewis was a rising young lawyer of the city, and one-time leader of the waning opposition to Dunellin's overlordship of Flowerville. Dunellin had considered it a good move to make him vice-chairman of the Memorial Committee, and in that capacity he had acted as radio announcer at all the events of the week, the master of ceremonies before the great absentee audiences.

Dunellin's eyebrows elevated slightly now at the young man's unceremonious manner, but he yielded politely to his demand.

"Excuse me a moment, gentlemen," he apologized. "I'll run you home in my car, Tom," he added to old Thomas Carroll, the labor leader, who was one of the party.

"No, thank you, Mr. Dunellin," Carroll declined. "I'll get home just as quick by hopping the last trolley that's due out here about now. You've a car full, and these gentlemen won't care to ride all over town at this time of night."

"Just as you wish, Tom. I'll say good-night, then," Dunellin agreed.

"We'll walk over to the trolley with Mr. Carroll, and you can pick us up there," suggested Senator Nefus.

The Senator and Professor Mayhew were staying over-night at the Dunellin home.

"Seems funny to see Mr. Dunellin and Martin Lewis workin' together after the way they fought a while back," remarked Carroll as they started across the square.

"What was their trouble?" asked the Professor.

"Lewis claimed that Mr. Dunellin bribed the Board of Aldermen to get the contract for the water reservoir, and then stole a fortune from the city in skimped materials. He made charges enough to send Mr. Dunellin to State Prison for thirty years if he could prove it, but he couldn't. Mr. Dunellin, instead of suing him for libel, said the young man meant well, but was misguided. He's been throwing little things in Lewis's way ever since, and I guess the young fellow's changed his mind."

"Dunellin certainly has a gift for handling men," commented Senator Nefus.

"He has that," Carroll agreed. "Why, there's even that drunken old Mike Hartigan, the assistant janitor at the theater, we saw in the lobby just now waiting to lock up. Couple of years ago he was threatening to shoot Dunellin on sight for getting his boy sent up for stealing in Dunellin's bank. Well, Dunellin gets the boy pardoned after a year and meantime gets Mike this soft job at the theater. Mike swears by him now."

The Grand Theater stood at one corner of the city's square facing into it. Diagonally across it at the other corner was the trolley stop, about fifteen hundred feet away. The three men sauntered slowly across the grassy lawns, looking back occasionally to see if Dunellin's car had started yet. It was a pleasant Fall midnight, the air clear, cool and still. Nothing broke the silence but the occasional drone of a distant trolley-car.

They reached the car line and found they had a minute or two to wait for Carroll's car. A few feet away the patrolman on the beat was gossiping with a proprietor of the little general store on the corner. There was still no sign of Dunellin. Diagonally across the square they could see the light still burning in the manager's office of the theatre, where Dunellin had gone to confer with Martin Lewis.

"Must have had a lot to say after all," yawned the Senator.

At that instant, sharply distinct through the silence came the sound of two crackling explosions from the direction of the theater.

The policeman whirled about.

"Something doing over there!" he exclaimed and started for it on the run, blowing his whistle for help as he ran. The four civilians lumbered after him.

Two other patrolmen, summoned by the whistle, joined them as they reached the theater, but there was no other sign of life about the front of the building, whose main doors were still wide open as when they had left it. But when they poured into the lobby they came upon Martin Lewis standing at the foot of the stairs looking up.

He whirled toward them in nervous alarm. He was deathly pale and greatly agitated.

"Where's the shooting?" demanded one of the officers.

"I—I don't know. I left about five minutes ago and got half a block away when I heard it. It sounded as if it came from the theatre. I thought of Mr. Dunellin, first thing. I left him alone up in the manager's office. I heard you coming so thought I'd better not go up there alone."

The policeman bounded up the stairs, the rest following. On the first landing they met Mike Hartigan, the assistant janitor, staggering down.

"Where was it?" again demanded an officer.

"I dunno," Mike declared. "Sounded upstairs. I was takin' a bit of a nap waitin' for 'em to get through up there, and it woke me up. I got most up there when I think I don't know what I may be gettin' into; I better call a cop."

The officer pushed the partially sobered Mike one side, and they continued on. The door of the manager's office stood wide open. The little group pushed in, then stopped aghast.

In the middle of the floor under the full glare of the overhanging light lay Andrew Dunellin, his head in a pool of blood, his arms thrown wide and clutched in his right hand a heavy revolver.

For a full moment no one spoke.

"Good God! He's killed himself!" exclaimed Senator Nefus.

But the policeman who had been with them when the shots were heard and who, by tacit consent of the others, had taken charge, was on his knees closely examining the body and the weapon.

"How many shots was it you heard, sir?" the officer asked at length, looking at the Senator.

"Two," the Senator affirmed.

"I also," the Professor corroborated.

"Same here," agreed Carroll.

"Me too," from the storekeeper.

"I couldn't be sure," Lewis said. "I was around the corner when I heard it."

"Something doing over there!"

"I heard two myself," the officer added, rising to his feet, "but only one shot has been fired from that gun. The bullet that killed him went into his mouth and out the back of his head. Looks to me like murder. Somebody else fired that second shot."

"Jan," he added to one of the officers, "better scout around the building and see if you find any prowlers or signs of 'em. And, Joe, don't let any of these people out of here while I call the captain. I'll have to ask all of you to stay right here till the Cap decides what to do. Don't touch anything. There may be finger-prints. Where's that janitor? Don't let him get away."

But Mike Hartigan had vanished.

"It's murder all right and Hartigan's the fellow did it," was the unofficial verdict of Inspector Leebuck of the Detective Bureau, after he had looked the case over.

So the drag-net was drawn for old Mike. He did not return to his home that night, and it was late the next afternoon before he was picked up in the back room of a friendly saloon, now very drunk. His story told at the coroner's inquest after he sobered up was hazy and conflicting. He repeated his statement that he had sat down at the bottom of the balcony stairs to wait for Dunellin and Lewis to come out and had fallen asleep. He thought he heard somebody go by him up the stairs while he dozed. Pressed on this point, he said maybe they were coming down stairs, and finally admitted it might have been footsteps overhead.

He persisted, however, in the statement that the shooting awakened him, though he contradicted himself several times as to the number of shots he heard. He said he looked in the main auditorium first, then had started up the stairs, but he was afraid he might be shot himself so came back and met the officers. Again he contradicted himself as to how far up the stairs he had gone.

"But why did you run away?" asked the Coroner.

"I was scared fear they'd blame me fer goin' to sleep on duty an' lettin' the fellow come in that murdered Mr. Dunellin. Soon's I heard the officer say Mr. Dunellin'd been murdered, I says to muself, 'This ain't any place fer me,' an' I beat it."

He admitted he had been drinking from a hip-flask that evening, but denied that he had been irritated at Dunellin for keeping him so late.

There were several witnesses, however, who said they had been among the last of the general audience to leave and that old Mike had been in a

profane fury because people were so slow in getting out.

Others testified that at the time his son was sent to prison on Dunellin's charges, Mike had threatened to shoot him, and he had been known to carry a gun.

"Did you have a gun that night?"

"I did not, sir. Haven't had a gun in two years."

Martin Lewis' story was simple and direct.

"I went up to the manager's office with Mr. Dunellin, and we finished totaling the pledges made toward the memorial by adding those made after the meeting adjourned. He wanted to compose carefully a few pleasant words to go with his announcement of the total; said he would phone the papers and told me not to wait for him. He insisted he could work faster if he was alone, so I left, passing Mike sound asleep on the stairs when I went out; at least he seemed to be asleep. I had just turned the corner from the theatre when I heard shots and went back."

That two separate shots had been fired was established by the five reliable witnesses who heard them from the trolley station, the only persons who claimed to have heard the shooting clearly.

It seemed to be a clear case. The Coroner's jury found that Andrew Dunellin came to his death by a pistol shot fired by Michael Hartigan. Popular indignation ran high. There was serious talk of lynching old Mike, but this was suppressed by the prompt action of the police. There was universal demand for swift punishment. Mike Hartigan was indicted for murder in the first degree, and rushed to trial.

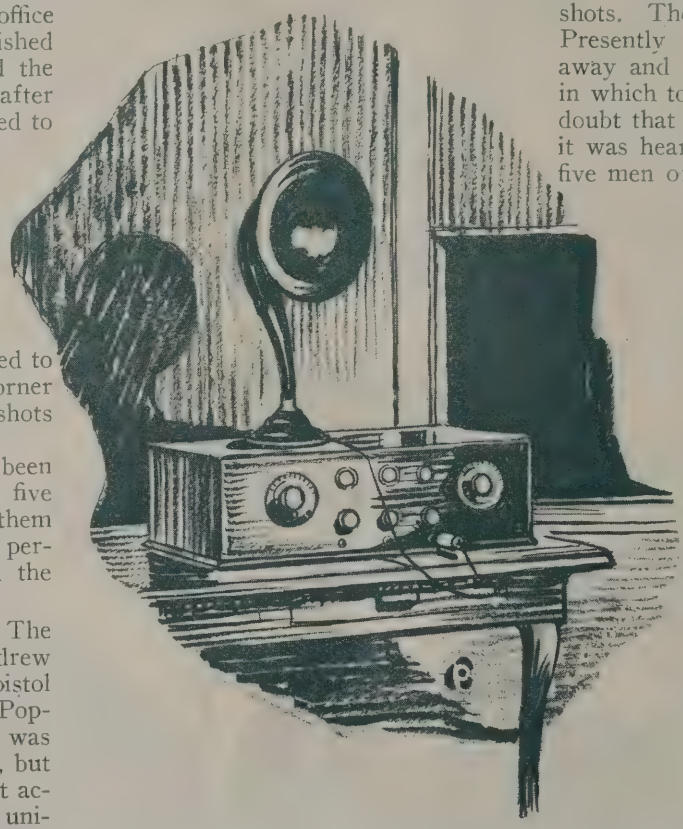
At this point there was considerable public surprise at the action of Martin Lewis. Neither old Milke nor any of his family or friends had any money to pay a lawyer to defend him. It looked as though his fate would have to rest with the perfunctory services of some minor attorney appointed by the court.

Then Lewis came forward and donated the entire resources of his law firm to the defense of the old janitor. His partner, Harvey Powell, one of the best trial lawyers in the state, volunteered to appear in court.

To the further surprise of everyone the defense rested its case mainly on the contention that no second shot had been fired, that it was a clear case of suicide, that those who thought they had heard a second shot had probably been deceived by an echo.

"We shall show further," said Attorney Powell in opening for the defense, "that the defendant Hartigan had been a staunch friend of the deceased for over a year; that there is no evidence that he had a weapon with him on the night in question, that if he had and used it, he was too befuddled with liquor to have so cleverly disposed of it on the spur of the moment that it has never been found."

But, though the defense had the advantage of the alleged weapon being missing, and produced numerous witnesses to Hartigan's present lack of motive, they were weak in their main point of contention, that there had been no second shot. Hartigan, himself, and Lewis both now swore glibly that they had heard only one shot and stuck to it.



Hartigan's testimony, of course, was passed over as controlled by self-interest, but the apparent change of front by Lewis caused some surprise.

"You stated to the officer at the time of the shooting, Mr. Lewis, that you were not sure how many shots had been fired," said the district attorney.

"I was not under oath then, and did not know that my statement might involve another's safety. I did not wish in the excitement of the moment to contradict positively several other reliable gentlemen."

The prosecution proceeded smoothly to carry out its program as outlined in the prosecutor's opening.

"The picture is so clear," said he, "that we can safely fill in the missing bits. The defendant, Hartigan, is seen about the theatre drunk and quarrelsome. He had been known to carry a weapon at times. Doubtless he had it that night. He is finally left alone at midnight, kept out by the man he still secretly hates. He broods over his present discomfort and past wrongs. Finally, he goes upstairs and berates his victim. When the latter rebukes him, Hartigan draws his weapon. Dunellin draws his, but Hartigan is the lucky one. He leaves his victim and as he goes down the stairs is met by five men, all of whom heard the two shots. The gun is safe in his pocket. Presently in the excitement he slips away and has nearly thirty-six hours in which to hide the weapon. Can we doubt that second shot was fired when it was heard and will be sworn to by five men of more than ordinary intelligence and probity, a United States Senator, a well-known scholar, a prominent labor leader, a reputable merchant, and a man of good standing on our police force?"

Inch by inch the defense fought this conclusion in vain. Their one chance of breaking down the testimony as to the second shot on the ground that the witnesses had been deluded by an echo failed on a field test. Court and jury adjourned to the trolley stop in the square opposite the theatre where the witnesses had heard the shooting. Shot after shot was fired in the manager's room of the theatre, but it failed to awaken any echo perceptible to the listeners. The acoustics of the theatre were too good to cause any reverberation. The buildings about the square and back of the theatre had neither the height nor position to throw an echo in that direction.

So when the defense was apparently at the end of its resources, it was evident that the prosecution would have the verdict. There was a hurried consultation between Martin Lewis and his partner, Powell, counsel for the defense.

"Your Honor, I wish to call Mr. Lewis to the stand again," said Powell, in evident agitation.

"Mr. Lewis," asked Powell, "Will you please state again exactly what happened on the night of the killing of Andrew Dunellin?"

Then Lewis threw a bombshell into the court-room.

"I wish to retract my previous statement and make a new one," he said. "In so doing I must convict myself of perjury, committed in an effort to spare the reputation of a man whom this entire community reveres and

from whom I myself have accepted many friendly favors. I did it further to spare as much as possible the feelings of that man's bereaved family. Further, I must admit frankly, I realized that to tell the truth would compel me to appear to the public as the cause of that man's self destruction. But now I find it necessary to tell the truth in order to save the life of an innocent man."

The witness paused and wiped the heavy beads of perspiration from his brow. Then, after a moment with a visible effort, proceeded.

"I was in the room with Andrew Dunellin when he shot himself. Only one shot was fired and that his own. Michael Hartigan is innocent. He was down in the lobby when it happened, as he swore he was."

He paused again and fought for self-control. Court, jury and spectators sat motionless, with tense white faces. There was not a sound in the court room.

"Some years ago," Lewis went on at last, "I made very serious charges against Andrew Dunellin in the heat of a political campaign. I thought I could prove them then, but I found I couldn't, and was forced to retract them. In time I came to believe I was wrong.

"On the evening that Andrew Dunellin died, just before I started for the mass meeting, a man called at my home and handed me three affidavits which I will present in evidence if the court permits. These documents supply the evidence I had failed to get and had come to believe did not exist. They prove that Andrew Dunellin obtained the water supply contract by bribery and made a fortune by using cheaper material than the contract specified.

"The man bringing me these affidavits was on the way to the newspapers with them. I made him promise to wait twenty-four hours, while I tried to get Mr. Dunellin to make voluntary restitution, I agreeing to have private detective agents watch him meantime, and see that he did not escape.

"I had no chance to see him till after the meeting that night, when I gave the pretext that we must make up a statement for the papers, in order to get him alone in the manager's office at the theatre. Then I put the whole matter before him. I told him he could not escape, but that he could lessen his punishment by making a confession to the papers that night, at the same time offering full restitution. I volunteered the services of my firm at his trial.

"He simply stared at me till I had finished. Then he shook his head.

"'I had feared this might happen some time,' he said. 'The restitution is arranged for in my will,' and before I could make a move, he drew his revolver from his pocket, placed the muzzle in his mouth and fired.

"My first impulse was to run for help. But as I ran I was thinking rapidly. I thought of the double blow of the suicide and the exposure to his family, friends and business. I thought that I would appear to have forced the suicide by threat of exposing him after accepting his friendship. Why not keep out of it and let it remain a mystery? I could get the affidavit withdrawn now that he was dead.

"I'd been sitting listening to the meeting all evening."

"On the last landing I saw Mike Hartigan staggering to his feet and looking wildly around. Then he went into the auditorium as he testified. That left the coast clear. I slipped outside the door and waited until he went upstairs, then I slipped back into the lobby till the police and others arrived. You know the rest. I throw myself on the mercy of the court."

Martin Lewis walked to his seat beside his counsel like a man in a dream. Powell arose and murmured perfunctorily, "Your Honor, defense rests."

The district attorney followed suit, and a few moments later the jury, without leaving the box, voted Mike Hartigan not guilty.

Following the verdict there was a moment of hushed expectancy, then the district attorney arose—

"Your Honor," he said, "I demand the arrest of Martin Lewis on the charge of murder in the first degree for the killing of Andrew Dunellin."

The entire City of Flowerville boiled afresh at this new and greatest sensational development in the mysterious Dunellin case. The case was tried a hundred times over in the newspapers, on street corners, in homes, restaurants, clubs and offices. There was much difference of opinion over details. Some declared Dunellin ought to have been shot and pronounced Lewis a hero. Others said the young lawyer was a desperate blackmailer, and had shot his victim when he was defied. Still others believed the shooting was in self defense, while yet another group maintained it was a quarrel between crooks, who had been working together, but had a falling out.

But all agreed on one thing—Martin Lewis had shot and killed Andrew Dunellin. There was not a chance in the world of drawing a jury that would vote otherwise.

The district attorney was jubilant. He didn't like Lewis. He was a strong partisan of Dunellin. There had been a lot of fumbling in this case. His office didn't stand any too well in the matter. Here was where he would redeem himself beyond question. The only fly in the ointment was that the case was too easy.

"Lewis has hung himself," he exulted to his assistant. "He and his partner tried every dodge in the Hartigan trial to prove only one shot was fired and failed. He's admitted he was in the room when it happened. He admitted and proved the best ground in the world for a deadly quarrel. Of course he had a gun with him. Would any sane man go into a room alone with Dunellin to prove he was going to expose his crookedness without having a gun with him to defend himself, and be darned good and ready to use it?"

In his interview with Lewis, Powell, the prisoner's partner and attorney, voiced much the same opinion.

"Martin," he said, "I'll do my best, but we're up against it. We can't get around that second shot. If you'd told the truth at the outset, admitted shooting and claimed self-de-

(*Turn to page* 76)

Radio and Family Education

Radio is almost an ideal educating influence because it induces manual training and is filled with a constantly increasing lure into wider and deeper technique—it establishes direct personal connection with the world of ideas and events

By MRS. CHRISTINE FREDERICKS

I HAVE four children—one just out of baby clothes and another just out of knickerbockers. What every mother knows is that education is a great deal more than sending youngsters to school. "Education" starts with the never-ending baby-questions of Carol, the youngest, up to the actions of David, the oldest, when at the wheel of the family automobile. If anyone should ask me what word is most synonymous with "mother," I would instantly reply "university," for I have found it necessary to make my home into an institution of education, with myself as dean of the university, and father—like most university presidents—a more or less absentee and ornamental head!

This home university is no mere figure of speech. My home must offer —and does, to a large extent—a liberal arts curriculum and selective, vocational courses; a summer school outdoors, and evening classes to boot. Also a kindergarten, and once in a while a special corrective course for a temporarily wayward or abnormal child. And, like a modern institution of learning, there must be plenty of amusement, social life and, above all, a good "mess hall" with plenty of nourishing food. A library and a museum and a campus and athletic facilities are matters of course, according to the status of your pocketbook.

As dean of this family educational institution, with a very small faculty of teachers, I or any mother needs every bit of assistance that can possibly be afforded; especially so since the modern psychologists tell us that a child's character is formed largely before it ever gets to the schoolroom. There is no substitute for this home university; even the charity experts now realize that children in orphan homes and other institutions are usually better off if they have a family atmosphere, even if it isn't of the very best.

What is so hard on mother, the dean of the home university, is that she so often has to do practically all the teaching—conduct all the classes. Fathers, from the stone age onward, never were much at professoring in this home university. Mother has had to be kindergarten teacher, librarian, tutor in Latin, chemist, cook, chambermaid and matron.

You can imagine, then, how the intelligent mother has welcomed radio. It has put at her disposal a whole line of teachers, and added thousands of people to the home university faculty. It has been just as though the combined teaching staff of Harvard and Yale were suddenly placed at the service of some little college down in Arizona. Yes, quite!

Of course, I know that the great bulk of mothers haven't yet realized what a help they have in radio, even if there are sets in their homes. The sad fact is that the men of the family—husband, brother, son or grandfather —have so monopolized the radio set that mother in many cases knows nothing more about it than that she can't get hubby to bed at any decent hour any more, and that the "A" battery boasts a very nasty acid which has several times nearly ruined her rugs because of improper or careless handling.

When the radio fans give her a chance to regard the receiving set as a piece of household equipment of more value to her than anyone else we will begin a new era for the home university.

First there will be the little children. It is true that they must patiently be initiated into radio, if they are really to like it. A little child has quick likes and dislikes, and if you try to make it listen to things without interest you merely form a distaste. But if you induct children into radio rightly they will love it. Probably no man in the world ever has swayed so many children at one time as the famous "Man in the Moon" in the early days of radio. A lot of purely adult fun has been poked at the bed-time stories, and they are not now so much in vogue largely because of the selfish impatience of adults who did not want to listen in to baby prattle.

But mother and the children are going to demand their share. They will insist on other things than prize fights, political conventions and other man-interest programs. They will want good stories for the children, and more of the function of the "Man in the Moon," because many a mother can testify to the strong influence this able broadcaster had over her children. A private tip to the "Man in the Moon" about a little boy's naughtiness—the incredible magic and awesomeness of hearing his name and his misdeeds spoken about from out of the air, in a grieved voice has had a correcting influence beyond comparison. And to

the well-behaved—the word that a star had been made for him or her has been a satisfying reward.

My own youngest children are story-crazy. Father is besieged the moment he arrives home for his daily quota of two stories which necessitates the reading of endless fairy story books. The story is, of course, an age-old educational device. Example, even in fiction, is the best teacher. The story over the radio affords endless opportunities as an educational aid for the younger children. I am sure if my husband's stories were broadcast they would induce the same rapt attention from other children as they do from our own little ones. Even for these little children a broad range of material coming over the radio is educative.

As for the boy in the family, radio is as full of education as the sea is full of salt. He gets it first, merely in the sharpening up of his interest. Every mother knows the heart-rending cry of the boy, "There's nothing for me to do, mother!" But once caught in the net of radio interest, it's a poor lad who isn't in for a year or two at least of experimenting and brain-teasing!

Radio is almost an ideal educating influence, because it not only is manual training, but is filled with a constantly increasing lure into wider and deeper technique; while to cap the ideal climax, it establishes direct personal connection with the outside world of ideas and events. I used to believe a printing outfit did this, combining, as it does, manual work with words and ideas; but radio infinitely surpasses it. Small wonder that radio set-building is now a standard manual training equipment in schools.

In my opinion it is a serious mistake, an injustice to any boy—and I believe also to a modern girl—to let them grow up without a practical knowledge of mechanics and electricity. A man finds it necessary so very often in life to use practical mechanical knowledge; and in this day of electric washers, ironers and vacuum cleaners, a woman does, too. Radio, considered simply as manual training, is a splendid practical as well as a theoretical education. Few, if any, subjects lead out into more sciences, or tap the sources of all scientific knowledge more fully than radio. A youngster who knows radio is almost certain to know a lot about science, physics, chemistry, and allied subjects.

It is even true that grown-up women are acquiring a needed education in electricity via radio. There is often the most ridiculous ignorance on women's part about electricity. They send for electricians to do a little job that anybody could do in three minutes; often they send for him when they don't even need him at all—they have simply been stupid. Electricity is the modern woman's servant to a very large degree. So radio is in a sense bringing up mother, if she takes an interest in it.

Considered as musical education, radio is a vastly important thing. You might say the phonograph has done all you can expect from radio in musical education. The blunt truth is that the phonograph is canned music, while radio is live music. My young people don't want to listen to an orchestra phonograph record. They get no thrill because they know it is canned. But they will listen to a Philharmonic concert, or some other high class music, on the radio. As

"Home Sweet Home," with all of its constructive power to support and advance civilization, has been enhanced by the introduction of radio broadcasting

a rule, they prefer to dance by phonograph music, it is true, because it takes sheer volume and clear time-marking to make dance music enjoyable. But the musical thrill in radio for young people is the sense of attending an actual event; listening to an actual performance. The telephone has habituated us to regarding what we hear over the wires as real, so that the intervening distance and the ear-piece does not destroy the sense of reality.

Educationally, the musical value of radio lies in forcing upon the attention of young people some of the beautiful compositions. Left to themselves they will not play records of "The Unfinished Symphony," or "Scheherezade" on the phonograph; but if a good orchestra plays it they'll enjoy it. There should, of course, be more of the better type of music, especially music presented educationally, as some of the New York *Globe* concerts were presented. More broadcasting of the music of the big orchestras is also bound to come, and will be a very great educational boon.

It is not generally appreciated that young people at boarding schools find radio a joy. My son, now at prep school, who had surfeited himself with radio at home, found himself calling loudly for a set once he got to school. School rules requiring lights out at 10 P. M., he and his chum discovered that it did not refer to radio tube lights, so they went to bed and listened in until sleeping time. Thus radio became an excellent preventer of old-time mischief, no doubt!

I find my youngsters are more interested in the broad world of affairs since we have had radio in the house. They take note of major political, business and other events. They ask questions and make dinner table conversation with the newly broadcast information. It is true, they often exercise their lordly prerogative as listeners in to tune out, just as those in a meeting may boo a poor speaker. But on the whole they collect, in their own way, their quota of fact and impression, all of which is educative because it presents data to the mind for a judgment.

The other evening some singer over the radio sang a sentimental ballad about "the salt, salt sea." My graduate class, the older two children, laughed him out of earshot—but they went to our home university library and got out a reference book to settle a dispute that arose as to how the sea ever got salty, anyway! Thus does the difficult business of home education proceed along the narrow road of interest—something which radio never fails to stimulate in one direction or another, even if only to tune out that old bore, quick!

For a long time I was not able to keep my youngsters interested in calisthenic exercises. Then when a broadcasting station put out Walter Camp's daily dozen, I got them interested. We put a loud speaker out on the lawn, and the whole family, including the help, took part to the rhythm of radio!

Children's hour is now filled with new and old fairy stories that improve the child mind more effectively than could be accomplished without radio broadcasting

Another time, we stimulated flagging interest in rhythmic dancing in the same way—out on the lawn to the time of good dance music via radio.

This summer I discovered my very active nine-year-old girl crying because school was over and she didn't have things to do any more! I realized that a summer school must be organized on the spot; and I turned to radio for help. She is such an active child that it was difficult to get her started, but now she knows how to tune in all by herself and has caught the long distance fever. Her DX work has been associated with her geography lessons. I supplied her with a map, and now she is getting a whole new set of educational thrills working out the various stations, and acquiring, at the same time, a stimulating medley of impressions from the broadcast music and lectures.

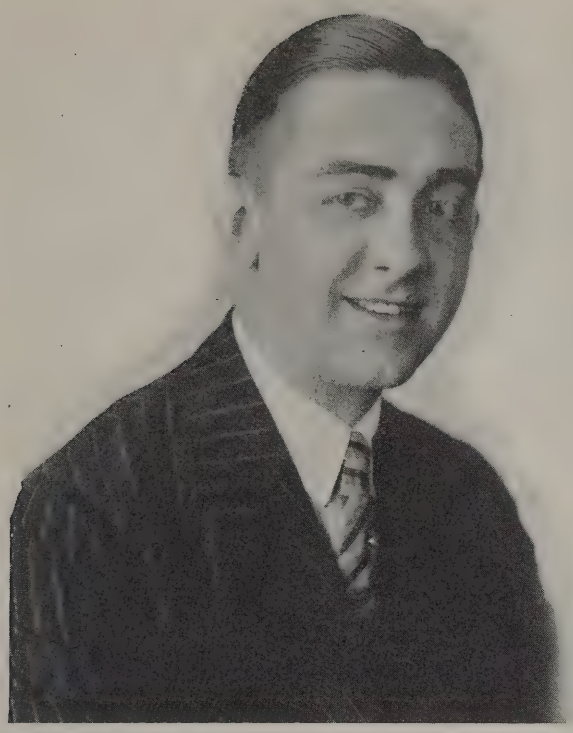
One of my children was unlucky enough to be laid up with illness for a period in the school season, and it was a great trial for her to discontinue lessons. Radio stepped into the breach and kept her contented and alert.

My radio faculty is very important in my home university. It has lifted a considerable load from my shoulders, and will lift more when, as I contend should happen soon, there will be more attention paid by broadcasters to the needs of the family.

And now I'll come to the education by radio of the adults themselves. There's more than a jest behind the modern quip about educating father and bringing up mother. I have been a Chautauqua lecturer throughout the entire United States, and I can testify from intimate knowledge as to how important the educational aspect of radio is to the adults of the great stretch of territory of this country. The annual Chautauqua lectures have been almost the only education which millions of people have had—their one contact with outside educative forces. Great as are the circulations of our magazines and newspapers, they are plainly but a drop in the bucket. There are 25,000,000 homes in the United States, and the most optimistic publication men have never claimed that more than about 7,000,000 of these families read magazines or metropolitan newspapers. The rest may read the local gossip and the outstanding telegraph news in local papers, but a surprisingly large number never even do that. Education through the printed page is not the easiest or simplest method whereby to educate people. The mighty vogue of the movie has shown us that, for about 15,000,000 families see the movies. The eye and the ear are the masses' greatest tools for education.

Radio can easily put education into every home, since radio sets are now so cheap. When I recall the pathetic sight I saw in Florida, of two small children traveling each day, through swamp and woods and by row boat,

(*Turn to page* 65)



"Selling" the Movies by Radio

Movie chats over the air prove a boon to meritorious pictures and are popular with the "movie fans"

By ALFRED J. "HOLLYWOOD" McCOSKER

PERHAPS the best way for me to take the harshness out of the word, "selling" which occurs in the title of this article is to tell a story.

Also, it will make us both feel at home because it is largely through the medium of story-telling that I have become known to the vast radio audience and through which genuine friendships that I hold invaluable have had their beginnings.

When in my radio talks, which deal with the cinema, I wedded the "whisper world" with the "shadow world," no thought of "selling" was in my mind. But, as the talks continued, that is exactly what happened and here comes the story. I was placed very much in the position of the maiden lady whose nightly prayer was, "Please, God, I don't ask anything for myself, but do send mother a son-in-law."

More than a year ago, while I was in charge of the motion picture department of America's oldest theatrical daily newspaper, a glorified old sheet published in New York, the thought occurred to me that everyone was apparently interested in the slightest whisper of inside information concerning motion pictures; an indication that I gleaned in my social life away from the industry. Added to this was the fact that nearly everyone was interested, if not enthusiastic, about radio. The radio audience, which comprises the dual personnel, might, I speculated, approve a weekly feature talk in the realm of the silent screen. I believe now, and have for a long time, that I was right in my assumption.

But do you know, when some of the leaders in the ranks of theatre owners learned of my intention to send movie chats over the air they were up in arms. These earnest gentlemen saw the advent of the radio only as dangerous competition that must be stifled if their enterprises were to survive or if ever the "SRO" sign was to flash under the electric lights. Some of the most important executives in the exhibition branch of the industry urged me to abandon my projected radio talks if I had any regard for long friendship—and their pocketbooks.

"How," they argued, "can you expect people to be at home listening to your radio talks about pictures and at the same time be at the right side of the box office of our theaters?" The answer was simple. I could not expect them to be in two places at once. But what I could expect without recourse to phenomena, was that people might be in one place listening via radio to news of meritorious movies and at the same time, desire to be in another place witnessing them. It is only true to report that this is precisely what happened. Thousands of letters I have received from newly made radio-movie fans attested the truth of my original contention.

I will add here that my radio talks may not have been good for all pictures, but they have proven a value to theater owners who featured the better ones. By nature I am a booster. I preferred not to mention by radio any picture which did not merit a good "send-off." The radio audience was speedily alert to this and the plan saved me from joining the obnoxious ranks of "panners" as chronic fault finders are known to film profession. Correspondents have written me, saying, "I went to see such and such a picture and now I know why you did not mention it in your radio reviews."

(*Turn to page* 82)

"Baby Peggy," the tiny movie star of "Captain January," tunes in to McCosker's talks

Speech and Music in the World of Sound

Characteristics of harmonic vibrations — pitch, quality and loudness of notes and overtones analyzed—a scientific treatise on sound as related to speech and music

By JOHN P. MINTON, B. S., Ph.D.

IN the paper in the August issue of this magazine on "The World of Sound" we described the parts played by the vibrating objects, the air and the ear in the sensation of sound. It was necessary to have objects with little quivering motions and it was necessary to have the surrounding ocean of air to conduct or direct these motions throughout all the surrounding space. Some of this sound energy fell on the ear and produced the sensation of sound as related in our paper on the human ear which appeared in the July issue of THE WIRELESS AGE. In the present paper on speech and music we shall deal only with the vibrations of the objects themselves as related to speech and music.

The vibrations of material objects such as used in speech and music are very special kinds of vibrations. We can all recognize our own spoken language, many can understand several foreign spoken languages. We can detect the differences between a piano and a violin; we can recognize the sound from two musical instruments of the same kind as being markedly different; we can perceive with the ear the marked differences that exist between the same note when played by the piano and organ, or when sung by two voices. Why is all this possible? I shall endeavor in a simple way to explain why this is possible.

Any one of us can see immediately that there must be something regular and unchanging, continuous and sustaining, about such sounds as are produced by the mechanisms, so to speak, we have named. Surely, we could not hope to have the ear and the brain perform in so remarkable a fashion as they do, if such sounds as mentioned here were irregular and changing, discontinuous and not sustained. Sounds of the latter type are for the most part mere noises and are unpleasing and irritating to most of us. It is difficult to identify them. If we are able to identify them to any extent whatever it is because some sounds of the former type are present to a small extent. What then are the characteristics of the sounds of which speech and music are composed?

Let us consider music first. We have stated that objects must vibrate in order to produce sound. There is one type of vibration which physicists call simple harmonic vibration. Ohm, who was a professor of physics in Munich about 1850, and who gave to the electrical world the law known by his name, definitely introduced the idea that the simplest and most fundamental type of sound sensation is that which is caused by a simple harmonic vibration. The most familiar illustration of this simple type of vibration is the swinging pendulum. It swings back and forth about its mid-position at a constant rate, never varying. If we take a string, suspend a weight from one end, hold the other still and give the weight a tap with a hammer, we shall observe that the time of complete to and fro swing remains absolutely constant as the motion dies away and the weight comes to rest. The time of vibration determines the pitch or frequency, which is the number of complete to and fro motions which occur in one second. If we have any body vibrating in these simple harmonic motions, it causes the air molecules to swing back and forth with it in the same kind of motion. If the motion is rapid enough, say above twenty or so per second, the ear will hear them. If they are too rapid, say above 20,000 per second, the ear will not hear them. This has been explained in our first paper. The actual range used in speech and music is much more narrow than this; perhaps it includes all frequencies from about 30 to 8,000 or 10,000 cycles. Cycle is a term which applies to a single complete to and fro motion of the vibrating body.

In music the sensation of hearing produced by a simple harmonic motion is easily recognized and is called a simple tone, or a pure tone, or merely a tone. In music, produced by either voice or musical instruments, the sounds are more complex and are referred to as musical notes. These latter are composed of several pure tones and, when we investigate these notes and analyze them by physical apparatus at our disposal, we find that the frequencies or pitches of the various tones comprising a note are to one another in a very special relation, namely, they are proportional to the simple whole numbers 1, 2, 3, 4, 5, etc. These overtones, so to speak, are called harmonics, and are known by their respective numbers such as first, second, third, etc.

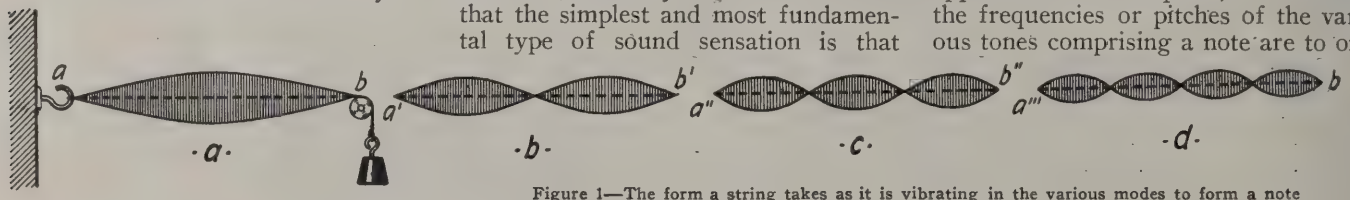


Figure 1—The form a string takes as it is vibrating in the various modes to form a note

There are three terms which are used to describe a note, namely, pitch, quality and loudness. Pitch of a note is ordinarily determined by the tone of lowest frequency in the note. By quality is meant the unmistakable character which enables us to distinguish the notes of one instrument from those of another. Quality is determined by the harmonic tones present in both number (such as first, third, etc.) and in magnitude. These alone enable the ear to detect the differences between the voice, the piano, the organ, the 'cello, the flute, the violin, etc.

As to loudness, this is of a psychological character, but it is associated with the magnitude of vibration of the air molecules or the sound pressure

acting on the drum membrane of the ear. The ear can judge loudness accurately between two pure tones of the same pitch, but it cannot judge with any degree of satisfaction the relative loudness of two tones of much different pitch or of two notes from different instruments.

Since the present issue of this magazine is an educational one, the above rather didactic discussion is in harmony with this purpose. It is of considerable value and of much personal satisfaction to be familiar with the above terms and to know to what they apply.

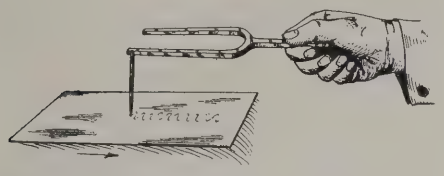


Figure 2—The simple harmonic vibrations of a tuning fork

We are all familiar with the fact that musical instruments fall into two general classes, the string and the wind instruments. The former type includes the piano, the guitar, harp and mandolin, the violin, viola d'Amore, viola Da Gamba, etc. These are all string instruments, some are plucked, one struck and some bowed, yet they are all recognized when played as being different. The reason is that the notes and quality of the music from each instrument is different than that produced by all the others. As already pointed out, the quality difference is caused by the presence of the harmonic tones. A change in the mechanical construction of the instruments brings out or changes the relative magnitude of the harmonics and introduces too, when new lengths of strings are used in the modified construction, a new set of fundamental tones and overtones, and we have therefore, a new set of string instruments. It is not the difference in the strings of the instruments of the same kind which cause one instrument to be superior to another. We know that the strings of an instrument play little part in determining the quality of music given off from the instrument. In fact, practically none of the sounds come from the strings of any of the string instruments. They really come from the body of the instrument or the sounding board as in a piano, all of which are set in motion by the vibrating strings themselves. Since the body of any one kind of instrument made by many different manufacturers is certain to be different in many important details of construction, it is at once apparent that these instruments will produce different musical quality. This is what determines the value of an instrument. With the violin, for example, much care is taken in the finer instruments in their construction, and the quality of their notes will change with age because the body is apt to alter. We really hear the body and for this reason certain of the older violins are a really great treasure. The most famous of all, of course, are the violins made by the great Italian violin maker, Antonio Stradivari, whose wonderful work was done from about 1666 to 1737. None since have equaled him. Let us now consider the vibration of the strings themselves.

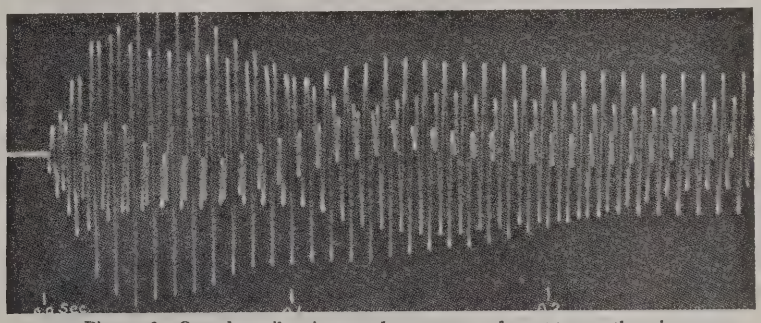


Figure 3—Complex vibrations and overtones of a note on the piano

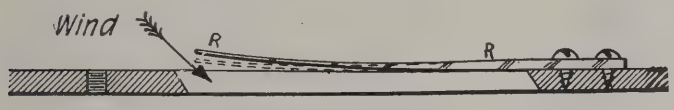


Figure 4—Metal reed and reed pipe

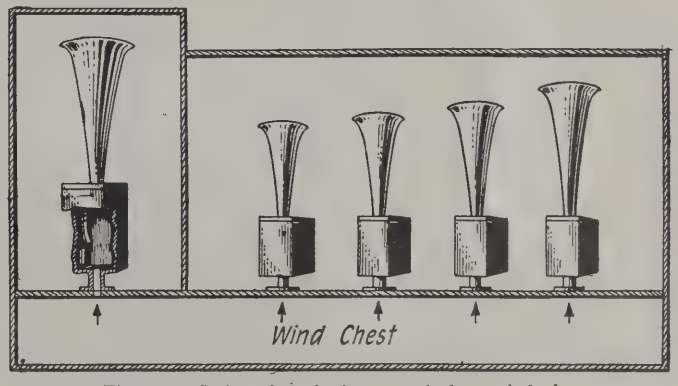


Figure 5—Series of reed pipes attached to wind chest

In figure 1 is shown a picture of the form a string takes as it is vibrating in the various modes to produce a note. The first mode (a) is the fundamental one and produces the lowest tone of the string; (b) is the second mode and gives the next highest tone which is octave of the first tone and is twice the pitch or frequency of the first tone; (c) the third mode, is three times the frequency of (a); (d) is the fourth mode, and is four times the frequency of (a). The tones given off by (b), (c) and (a) are the second, third and fourth harmonics of the tone produced by (a). Each of the modes (a), (b), (c) and (d) produce a pure tone and is a simple harmonic type of motion already referred to. If, however, the string is vibrating in all the forms shown in the figure, or if we have four different strings, one vibrating as (a), one as (b), etc., then we have a note given off instead of a pure tone. In music, of course, the vibrations are of the more complicated type and for this reason we hear notes entirely and the resulting sound is much more pleasing and satisfying because of the many fine variations a musician can produce. I venture to say that music would be far from pleasing if we had only pure tones at our disposal. It is of utmost importance to know that a given string vibrating simultaneously in all the four modes as shown in figure 1 will give, say a violin note on a violin body, a mandolin note on a mandolin body, a piano note on a piano body, etc. That is, the body controls the magnitudes or intensity of the harmonics and thus the quality or nature of the music.

It is of considerable advantage to study music and speech by means of pictures of the vibrations. In this way we discover many important things about them and are able, as a result, to develop new and greatly improved reproductions of speech and music. This is our constant aim. In figure 2 is shown an easy way in which a picture can be made of the simple harmonic vibrations which produce the simplest kind of a sound sensation as first announced by Ohm many years ago. The tuning fork, here shown, gives this

type of a sound wave. The smoked paper *m n* is moved along at a constant speed and the vibrations of the prongs are recorded on the paper by the light pencil at *p*.

In figure 3 is shown a more complicated type of vibration. It is secured only by careful scientific manipulation which need not be described here. The curve represents one of the low notes on a piano. These low notes of a piano are rich in harmonics or overtones. An analysis of such a curve as this shows there are more than ten harmonics present all of which go to make up the quality of the note heard. Such curves as these can be analyzed by physical methods and we then find out not only what tones are present, but to the exact degree or amount they are present. In this way it is possible to find in precise physical data what the real difference is that makes one instrument or voice different from another instrument or voice.

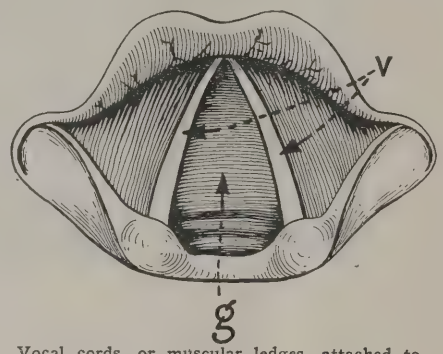
There is another large group of instruments, known as the wind instruments, whose action depends upon vibrating columns of air instead of moving strings. In this class we find a large variety of instruments. For example, we find here the organ, oboe, English horn, bassoon, double bassoon, flute, piccolo, clarinet, French horn, trumpet, trombone, tuba, cornet and many others. The vibrations are for the most part confined to the air columns or enclosed air. Some sound, but not much, come from the material of which the particular instrument is made. For example, all of us are familiar with the "brassy" sound from the band instruments, particularly when the sounds are very intense.

If the reader will refer back to figure 1 and imagine the string is an air column of one of the wind instruments, he can readily comprehend the type of motion the confined air undergoes for the different modes of vibrations. Here, however, the air particles move back and forth along the column and are called longitudinal waves, as all air waves are. The string vibrations, on the other hand, are all transverse to the direction of the strings.

We shall have opportunity in another paper to write more about these musical sounds, and for this reason let us consider the voice sounds in the remaining space allotted to us. We shall not be able to cover the whole subject, but we shall be able to include some of the essential facts. The discussion will be carried further in another paper.

The human voice is the most wonderful instrument of all. It can produce all the beautiful, finely shaded notes whose tones include practically every pitch in the whole frequency range from less than 100 cycles to 10,000 cycles. Its performance is matched only by the ear itself and neither the hand nor mind of man can make or conceive instruments more wonderful than these two.

To show the action of the human organs producing vocal sounds, it will be best first to describe the vibrating metal reed to which different pipes have been added as in the reed pipes of an organ. In figure 4 is shown a sketch of a metal reed, *RR*. The reed is a strong spring and sets its own rate of vibration. The wind is blown from the wind chest (see figure 5) as indicated by the arrow and maintains steady vibrations of the reed which causes a note to be produced. In figure 5 is seen a series of resonating pipes, with enclosed reeds, attached to a wind chest. These different pipes



Vocal cords, or muscular ledges, attached to the larynx as indicated by v. The cavity g controls the harmonic tones set up by the vibrating larynx

give various qualities to the notes because each pipe is of a different size and, therefore, brings out or emphasizes certain overtones. The overtones emphasized by each pipe are different because of the difference in size.

The human voice is the same type or nature in its performance as the metal reeds, the wind chest and the pipes. The lungs correspond to the wind chest and produce the wind or driving power. The larynx compares with the reed we have just described. The mouth cavity with its various configurations corresponds to the various pipes. This cavity can readily be formed into various shapes to control the harmonic tones and their magnitudes set up by the vibrating larynx. Attached to the larynx, as shown in the accompanying picture, on either side are the vocal cords which are a pair of muscular ledges, so to speak. These muscular cords can be stretched at will and the varying tension in them gives us the soprano, contralto, tenor, bass, etc. It also gives us the variations in any one voice and makes it possible to produce with the help of the changing mouth cavities all the fundamental tones with running accompaniment of overtones which are the means of speech and musical sounds of the voice with every shade of beauty and inflection. The infinite delicacy and variety of the tones thus produced by the voice are equaled only by the wonderful delicacy of the ear which distinguishes them and the brain which interprets them.

It would be unfortunate to leave this interesting subject of speech and music at this point and for this reason our next article will carry the discussion into the field of scientific data of tremendous import.

Standard Frequency Stations

AS a result of measurements by the Bureau of Standards upon the transmitted waves of a limited number of radio transmitting stations, data are given in each month's Radio Service Bulletin on such of these stations as have been found to maintain a sufficiently constant frequency to be useful as frequency standards. A new station, WBZ, is included in this month's list. There may be many other stations maintaining their frequency just as constant as these, but these are the only ones which reached the degree of constancy shown among the stations upon whose frequencies measurements were made in the bureau's laboratory. There is, of course, no guarantee that the stations named will maintain the constancy shown. As a means of maintaining constant frequency the high-power low-frequency alternator stations listed below have speed regulators. Most of the broadcasting stations listed use frequency indicators—one-point wavemeters—and maintain a maximum deflection of the instrument on the frequency indicator throughout the transmission. These broadcasting stations with rare exceptions, vary not more than 2 kilocycles from the assigned frequency. The transmitted frequencies from these stations can be utilized for standardizing wavelemeters and other apparatus.

Station	Owner and Location	Kilocycles	Times measured	Deviation Per Cent.
NSS	U. S. Navy, Annapolis, Md.	17.50	81	0.2
WGG	Radio Corp. of America, Tuckerton No. 1, N. J.	18.85	100	.2
WII	Radio Corp. of America, New Brunswick, N. J.	22.04	82	.3
WSO	Radio Corp. of America, Marion, Mass.	25.80	90	.3
WWJ	Detroit News, Detroit, Mich.	580	41	.1
WCAP	Chesapeake & Potomac Tel. Co., Washington, D. C.	640	56	.1
WRC	Radio Corp. of America, Washington, D. C.	640	40	.1
WSB	Atlanta Journal, Atlanta, Ga.	700	52	.1
WGY	General Elec. Co., Schenectady, N. Y.	790	89	.2
WBZ	Westinghouse Elec. & Mfg. Co. Springfield, Mass.	890	9	.0
KDKA	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	920	114	.1

Pompeii

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Geneva

Adventures of a Radio Operator

A series of true incidents of adventure, humor, pathos, history and travel, as told to the writer by a radio operator whose experiences they relate

By W. S. Fitzpatrick

Assistant Superintendent, Marine Department, Radio Corporation of America

HORACE H. WOODCOCK has had many interesting happenings; they may not be more than the average radio operator, but his were seen through observing eyes that delight in the unusual. He is well read and fond of travel and naturally appreciates the real value in sights of foreign lands. He is an ardent sportsman—displayed by his love of hunting, fishing, golf, motoring and his possession of a motor-boat—he enjoys the thrill of adventure.

Perhaps the excitement of being caught taking pictures in a forbidden section of the Mikado's palace and subsequent escape from the police by diving through an unknown culvert, may not appeal to you as an experience you would desire to pass through, but Mr. Woodcock, it must be remembered, is a full-blooded young American of a type who would find more sport in being chased by a band of savages on one of the southmost islands of the Philippines than to be entertained by the Governor-General in Manila.

This—I repeat—is Horace Woodcock.

He is fearless, as many of his experiences show, and he is very resourceful. His acting as chief steward of a ship on a voyage of several months after the regular steward had been left behind, is one instance. At another time, he took the part of ship's surgeon in treating an injured member of the crew, undoubtedly saving a life. Still another of the numerous examples is best described in an accompanying picture showing him in the act of untangling an aerial that had been blown down in a far-Eastern monsoon. In this case there was no spare wire aboard and it was necessary to rebuild the new aerial from the remnants of the old.

Horace H. Woodcock

To right—Mr. Woodcock untangling a much tangled aerial

Notwithstanding his intense, serious quest for new conquests, Horace Woodcock has a keen sense of humor. Note a sample in this letter addressed to a clerk in the maintenance department of the radio company:

"Aboard S.S. Java Arrow,
Bombay, India, March 22, 1923.

"Dear Sir:

"A terrible error has occurred which I must correct. It is this way:

"You gave me inventory sheets to fill out and told me to give one back before I sailed. I sailed right away and couldn't do it. So I mailed it to you before we left Port Arthur. I gave length of aerial spreaders as sixteen feet. Yesterday we had the aerial down on deck for rehauling and I measured the spars and found them to be twenty feet long.

"So in order to make them jibe with inventory I sawed off two feet from each end.

"I figured that some other operator might make a similar mistake some day, so I painted '16 feet' in large letters underneath each spreader, so it can be seen from deck.

"Now there will be no excuse for any operator following me, from sawing off any more.

"Respectfully yours,
"HORACE WOODCOCK."

Imagine the consternation at the radio office when this letter arrived! Such "Spreaders" cost over twenty dollars each and he had sawed four feet off each of them!

But the office force knew Woodcock and his pranks—they knew his letter was not to be taken seriously, so merely corrected the inventory copy that he had mailed in.

By this time you must have formed the opinion that Mr. Woodcock has an unusually impressive personality. You're right!

You would be glad to meet him and were you to ask his impressions of the various voyages he has made, he would tell you:

"Contrary to the general impression, sea-going radio operators do not have all their excitement on shipboard; life aboard is mostly routine and the man who participates in an SOS marks the day in red.

"The real thrill comes in stepping

ashore in a foreign country with the fixed determination to drink deep of the romance and legends of peoples whose history is lost in the haze of antiquity—wander through the streets of dead Pompeii; visit Karafeh outside Cairo; stand bathed in the mystic stillness of the Parthenon by moonlight or gaze upon China's great wall with an attempt to realize its vastness."

If you're a smoker, he will offer you his favorite brand of little cigars and try to convince you of their superiority over cigarettes; then with a "By golly"—his most common expression and the strongest ejaculation in his vocabulary—he will explain how indispensable is a camera on visits to foreign lands.

A few of the many pictures snapped by Mr. Woodcock. 1—Saw mill, Tokio, Japan. 2—Big Buddha, Kobe, Japan. 3—Familiar scene in Calcutta, India. 4—Native ferry on Woosung River, China. 5—A common sight in Philippines to see natives riding water buffaloes, which are tame to them, but not to white men

He has sent out his quota of SOS's—three of them thus far—but his most impressionable moments have been those of taking hard-to-get pictures.

Once, when visiting the Towers of Silence on Malabar Hill, Bombay, he slipped away from the guards and entered the gray stone circular platform where Parsee dead are left to the offices of vultures for burial. No living being is supposed to enter upon this platform other than the white-clad Nasasalars, to whom are entrusted the funeral rites.

Much excitement followed his detection, but no one seemed impelled to enter upon the platform. He could see from the gesticulations of the natives that curses were being heaped upon him, but the fate that was in store for him was his only concern for the moment.

He had succeeded in making three exposures—possibly the only ones ever made there—and he wondered if the native code called for death for this rash deed or merely being tied behind a fast horse as a penalty.

The sharp cry of an Englishman to "come this way quickly" brought him to his senses and he lost no time in following the instructions. The Englishman issued orders to two natives, presumably his servants, who escorted Woodcock outside to a conveyance, in which he was whisked away amid the growing excitement of the spectators.

A somewhat similar, but more thrilling, experience occurred to Mr. Woodcock in Tokio, Japan, prior to the great earthquake.

He was taken in a rickshaw to an entrance of the grounds of the Imperial Palace which he innocently entered without the necessary permit.

He walked unmolested about the grounds. Reaching a side door to the palace, Woodcock set up his camera and was just snapping a picture when an attendant rushed up and grappled with him to wrest the camera away.

He might better have tried to take away Woodcock's money or even his life, but the highly prized camera—never!

With one grand shove, Woodcock's adversary was sent sprawling in a corner and the intruder with his camera safe under his arm, darted around a corner and started down a long, narrow passage.

Two guards at the other end, spying him with a mysterious looking box, prepared to meet him. The fact that he was trapped flashed through his mind and with a thought of standing a better chance with the lone attendant than the two armed guards, he turned on his heel and increased his speed in the opposite direction.

Passing the door of the alcove where he had left the attendant lying, he saw him excitedly gesticulating and yelling to several uniformed guards who had been attracted by his cries for help.

They saw Woodcock too, and started in hot pursuit.

"By golly! I felt that the whole Japanese army was after me as I ran across the open grounds," Woodcock said, in relating the story, "and imagine how my heart thumped as I felt them gaining on me—then it must have stopped, for I felt my blood run cold as I came to an embankment about fifteen feet above a drained moat."

Although it was truly exciting, Woodcock talked in his usual calm voice. Proffering one of his favorite smokes and lighting one for himself, he proceeded:

"I expected to hear a bullet whiz by or else feel one passing through me. Why they did not shoot, I do not understand. Perhaps they did, but I was too excited to hear; at any rate, I wasn't hit.

"There was no time to lose so you can bet I lost none. My only recourse was to jump, which I did, then dodged through a dark culvert

"The soldiers evidently thought I would not be game enought to attempt passage through.

"By golly, it was no easy job plowing through that mud in the dark, but I finally made the other end. I glanced cautiously about and seeing no one, I climbed out into a small alley which led to a crowded street, through which I lost no time in getting to the ship."

Once in a North African port Woodcock and a radio man from another ship were approached by a native who, for a stated sum, agreed to guide them to and through one of the famous tombs of ancient kings.

With several officers of the ship the two operators returned and each of the party was provided with a donkey; then with two companions of the guide they started for the desert.

Let Woodcock tell the story:

"The donkeys were lazy and clearly showed they were in no hurry to get where they were going—in fact would just as soon stay home.

"As a means of impressing the beasts with the value of time and show that they were not violating any traffic rules in respect to speed, each guide carried a stick, which was freely used to the discomfort of the rider of the particular donkey receiving the unannounced whack.

"We were out in the open road when my steed received its first—and last—crack.

"Without warning either to the donkey or me the stick came down, the donkey's hind legs went up and I landed in the center of one of the largest cactus plants in all Africa.

"By golly, it took hours to extract those prickles, and don't think they didn't hurt through my thin clothes. Every man in the party assisted in the operation of removing them."

It was some time before they got on their way and eventually arrived at the promised tomb, which proved to be highly interesting, the pleasure of the visit being marred only by a demand of the guides for additional remuneration.

While in China during one of his voyages to the Far East, Woodcock noted a tower which appealed to him as being an excellent one from which to obtain good pictures of the town.

He found the tower to be a part of a public building, which he entered, and seeing no one, passed through a side door that brought him to a circular staircase in semi-darkness.

Reaching the top of the tower he secured some good pictures and was about to descend when he heard the cry of a baby.

Pushing open a side door he found a young Chinese girl chained to the wall of a small dark room and beside her a small baby.

From the girl's appearance and actions it was plain to see that she was in great distress and was in need of immediate help.

He rushed down the stairs and upon reaching the door found his exit blocked by a big, rough-looking Chinaman.

Woodcock was a little too quick for him and a well-aimed blow sent the man to the floor. Without loss of time Woodcock reported his find to the authorities but never learned of the outcome. The following day he discovered that he was being followed but as he did not go off the main highway and was then returning to the ship, which was about to sail, no harm came to him.

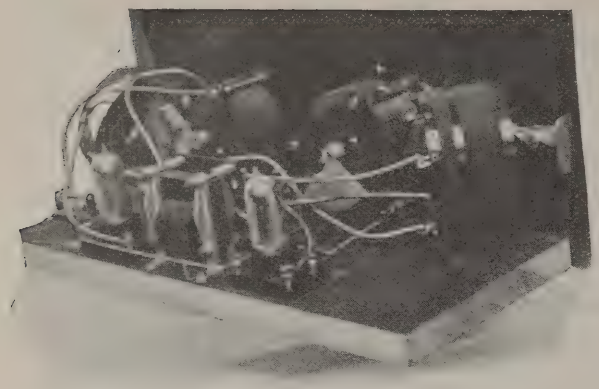
The following interesting description of Pompeii was written by Mr. Woodcock upon his return from a recent voyage to Italy:

The fortunate seafarer whose ship stays for a time in Naples seldom misses a visit to Pompeii situated on the shore of the Bay of Naples, almost immediately at the foot of Mount Vesuvius. To its proximity to this volcano it owes its celebrity; the peculiar circumstances of its destruction by the great volcanic outburst of Vesuvius in 79 A. D., and its rediscovery in modern times, converted that, which would otherwise have been known as as obscure country town, into a place famed world-wide for the most interesting relics preserved to us from antiquity.

A train ride of about forty-five minutes brings one to the entrance of the dead city where guides can be procured.

Mr. Woodcock's many other interesting experiences must be reserved for a later time. The pictures presented were taken from among his collection of thousands.

Some of Mr. Woodcock's art collection accumulated during his trips: 1—Statue of smiling Buddha, Dum-e-tey made of rosewood, from China. 2 and 3—Japanese prayers. These are placed in such a way that the wind makes them flutter, the idea being that every time they move it is the same as if the owner had offered the prayer. 4—Bamboo seat from one of the Sampans, China. 5—Japanese split bamboo pillow. 6—Japanese split bamboo basket. 7—Japanese palm leaf hat; the top is made from a single leaf and is reinforced on the underside with strips of bamboo. 8—Japanese bamboo rake used by farmers, street cleaners, etc. 9—Granite mortar and pestle from Japan. 10—Japanese comb made of wood. 11—Japanese tooth-brush. These brushes are supplied with towels to each hotel guest. 12—Japanese wooden shoes. 13—Japanese basket. 14—Purse from India. This has two compartments, one for copper coins and the other for silver. 15—Leather sandals from Bombay, India. 16—Brass lamp from Calcutta, India. 17, 18 and 19—Brass dishes from Calcutta, India. 20—Silver toe rings from Calcutta, India. 21—Silver arm ornament from India. 22 and 23—Silver ornaments from India. 24—Brass spray for scented water from India. 25—Brass container used for carrying betel leaves. 26—Marble ointment box from Genoa, Italy. 27—Manila sandals from the Philippines, (Chinelas). 28—Palm wood shoes with leather tops, Philippines (Bakia). 29—Wooden shoes with coarse woven tops. 30—Palm leaf fan from India.



How to Build the

Double Regenerative Reflex Receiver

An economical and easily made receiver that has done real work—loud speaker reception on two dry cell tubes of stations over a thousand miles distant

By R. A. Bradley

REGENERATIVE receivers with all sorts of variations have been used for years by American amateurs and broadcast listeners. There are probably more regenerative sets in use in this country today than any other type. This is undoubtedly due to the ease with which, the wholly inexperienced may construct one and the simplicity of operation. Every one knows the advantages of regeneration in a receiver—the tremendous increase in sensitivity and in signal strength. But nevertheless we reach a point in the sensitivity of a given tube past which it will not rectify—that is when the signal sets up such weak currents in the antenna that the detector tube fails to respond to the infinitely small voltage applied to its grid.

In order to extend the limit of sensitivity, amplification at radio frequencies is used to step up the signal voltage before it reaches the rectifier or detector tube. Most forms of radio-frequency amplifiers now in use are critical in operation. Because of the design of the transformers and the capacitative feed-back between the grids and plates of the tubes, the amplifiers show a tendency to oscillate. To prevent this several methods are used at the present time including resistance, inductance and capacity "oscillation preventers." Of these the most efficient is the "inductance preventer." If the transformer inductance or windings are properly designed the tube will not "spill over" and the amount of regeneration taking place can be nicely controlled.

The result of our experimentation in this line has been the Double Regenerative Reflex Receiver. It incorporates a regenerative detector with feedback coupling to a stage of tuned radio-frequency. The output of the detector is then fed into an audio-frequency transformer and reflexed back through the radio-frequency tube, making this tube operate at both radio- and audio-frequencies.

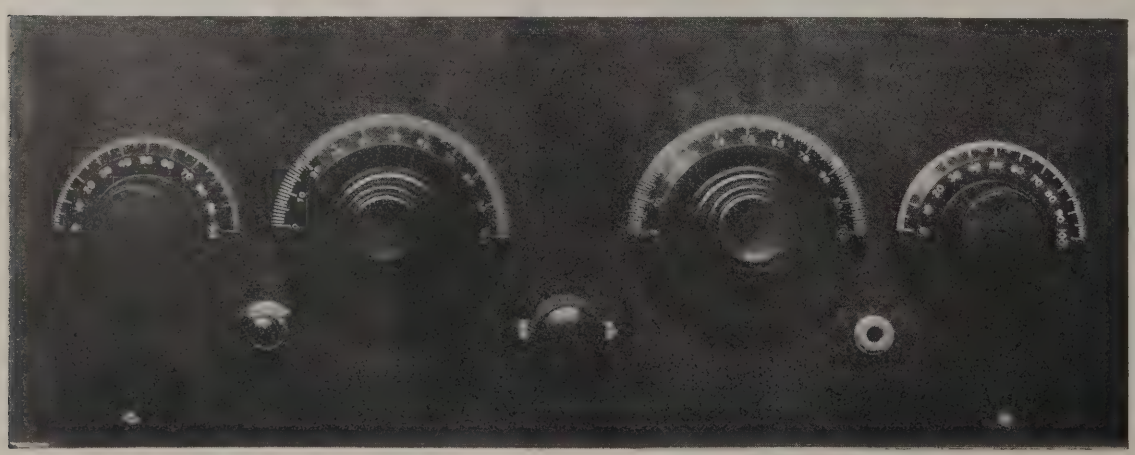
The action is as follows: Suppose we omit coil L3 in the circuit diagram for an instant. The transmitted carrier wave sets up currents in the antenna when L1 is tuned to resonance. The signal voltage is then impressed upon the grid of the amplifying tube. Greatly amplified it passes to the detector tube and is rectified and again amplified. Tickler coil L6 is adjusted so that the signal is fed back into the grid circuit of the detector tube where the action and advantages of regeneration are noticed. Suppose now we put in coil L3 and couple it to L2. We now feed radio-frequency current (amplified) back into the R.F. tube where it goes through the amplification over again. The operation of the reflexed current is, of course, known to all, therefore, we will not elaborate on it. But it is easily discernible what great possibilities there are in this double feedback.

We have given much time and experimentation to this receiver and it certainly has proved worthy of our expectations.

The volume obtained from this little two-tube receiver is about equal to a detector and two-stage audio set using six-volt tubes. And its reaching qualities in the way it steps out for distance will be a joy to the builder.

Construction of the Tuning Unit

The two tuners were made up especially for this set after the correct windings were determined. But they can easily be made up by anyone having two ordinary 180° vario-couplers. There should be 35 turns of No. 24 D. S. C. on the rotor coil of each tuner. Now remove the present primary winding on the outside coil and wind on 45 turns of No. 20 D. S. C. This forms the secondary wind-



Front panel view of the Double Regenerative Receiver

ing which is tuned by the variable condensers. After putting on the 45 turns there should be a space left of about ¾-inch on the tube. In this space and three-sixteenths inch from the secondary winding wind 10 turns of No. 18 D. S. C. This forms the primary winding which on the first tuner is the antenna coil and on the second the plate coil of the first tube. Two double honeycomb coil mountings using two 50-turn coils and two 35-turn coils may be substituted for these two tuning units. When these are used coils L1 and L4 are made by removing the plug attachment of the honeycomb coil and wrapping ten turns of wire around the outside and then replacing the plug. The honeycombs will not be so efficient nor as easy to handle, but will nevertheless be fairly good.

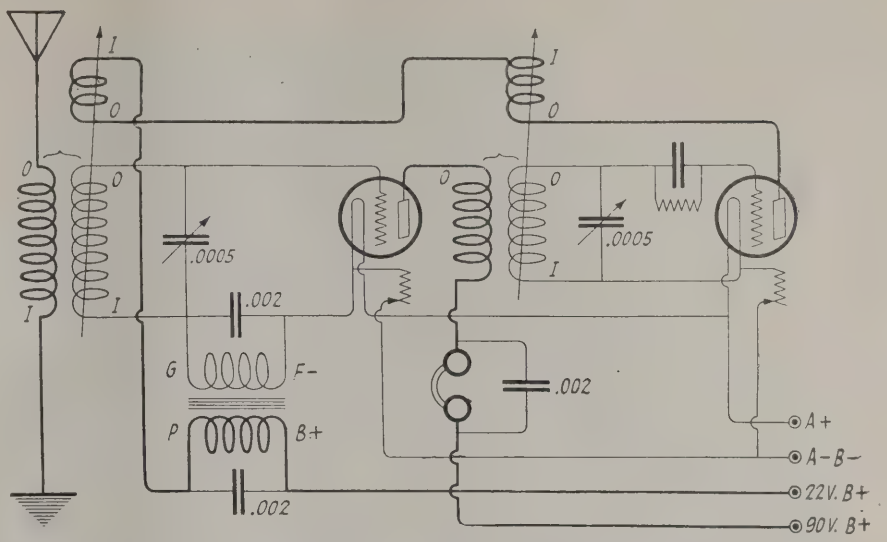
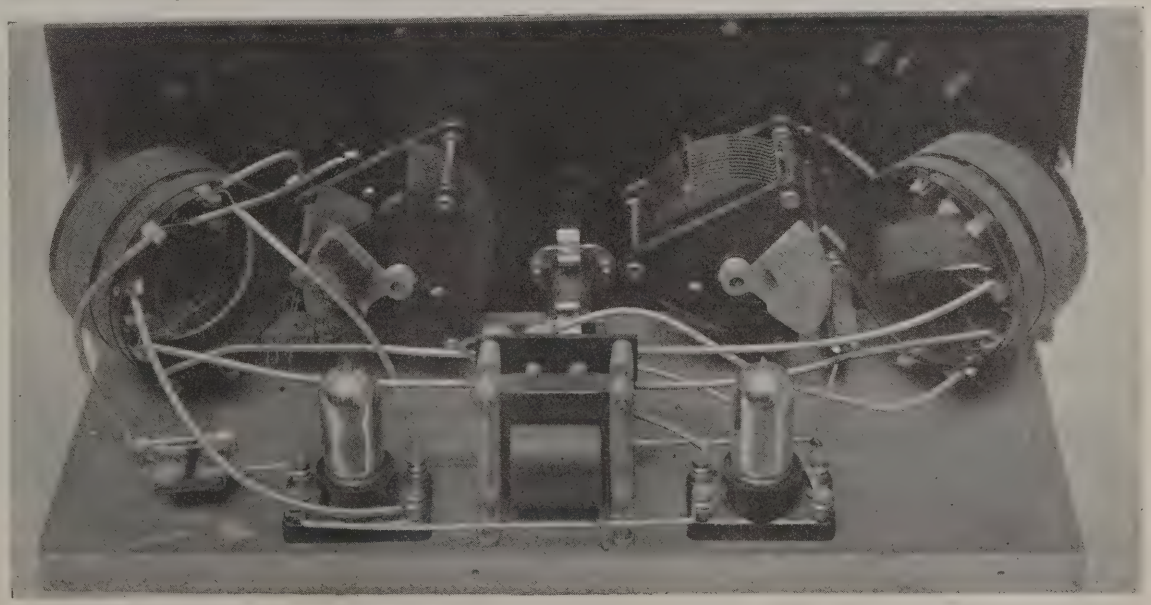


Figure 1—The two tube double regenerative circuit from which the set described here was built. Begin winding at 1 on the coils and end at 0

In the actual construction of the receiver the panel drilling comes first. The templates for the variable condensers should be carefully laid out on the panel and center lines marked for the drilling of the holes for the mounting screws. A pencil line drawn from one end of the panel to the other, three and one-half inches from the top, will provide a center line for mounting the two tuning units and the two variable condensers. After the panel has been drilled the two special couplers and the two condensers together with the jack and Fil-Ko-Stat and filament switch should be mounted on the panel before the panel is fastened to the baseboard. In fastening the baseboard be sure to use good strong brass screws at least seven-eighths of an inch long, because the weight of the condensers and other instruments mounted on the panel is considerable and a strong support is necessary. After the panel is fastened securely mount the two tube sockets and audio-frequency transformer securely on the baseboard with the transformer placed between the two sockets. If desired, room can be left for the addition of one stage of straight audio-frequency amplification, but this should not be required if the set is properly constructed. Do not attempt to hook up the set with bus wire as it will be a terrible task. Use No. 18 bare copper wire with a good grade of cambric spaghetti tubing. Make all connections as short and direct as possible. As usual it is necessary to connect the rotary plates of each variable condenser to the filament side of the circuit and the stationary plates to the grid side. If the circuit seems unstable or shows a tendency to spill over try reversing the primary terminals of the audio-frequency transformer. The UV-201A tube may be used very successfully with this receiver. Of course suitable sockets must be used depending upon the tube. Do not omit any of the fixed condensers shown in the diagram, as the receiver will not operate properly without them. We recommend that in hooking up the set you first use 45 volts on the plate of the radio-frequency tube and then 67 and then raise it to 90 if any appreciable gain is noted.

THE LIST OF MATERIALS NECESSARY

2—.0005 mfd. variable condensers (General Radio)
2—Na-ald UV-199 sockets
1—.00025 Micadon grid condenser
1—1½ megohm gridleak (Daven)
1—Fil-Ko-Stat
1—7″x18″ Condensite Celeron Panel
1—7″x17″x⅞″ baseboard
1—2″x7″ terminal strip
1—Acme audio-frequency transformer
3—.002 Micadon fixed condensers
4—3-inch Na-ald Dials
6—Eby binding posts
1—Phone jack (Pacent)
2—Tuning units which may consist of the two special wound coils as described in the text or:
2—Triple mounted spider web coils or:
2—Double honey-comb coil mountings with honey-comb coils



Rear of receiver with binding post sub-panel removed from rear of baseboard. All the connections are clearly shown. Note especially the two tuning units and how they are placed with respect to each other

Before we go on we had better give a short treatise on how to properly set the dials on a tuning instrument.

The dial on any tuning instrument should be an indication to the operator of the set as to the position of the instrument behind the panel, and although directly the dial readings mean nothing as far as wavelength is concerned, a comparison is drawn between the wavelength and the number on the dial. The dial on a variable condenser should be set so that when the rotary plates are completely out of mesh with the stationary plates, the reading should be zero. This will then mean that when the rotary plates are all "in" the dial will read 100. On a single-circuit regenerative set, or in any set where a tickler coil is used as a rotary member with respect to a secondary coil, the tickler coil is set at right angles with respect to the secondary coil, to give a zero reading on the dial. This will then convey to the operator that there is zero feedback or no feedback. When the tickler coil is parallel to the secondary coil and the maximum amount of feedback is obtained the dial will read 100. In a vario-coupler, which incorporates the antenna tuning circuit and the secondary or grid circuit, when the rotor coil is parallel to the stator coil, there is a zero amount of coupling and likewise a minimum of induction. When it is set at 100 the rotor coil is parallel to the stator coil and maximum of inductive coupling takes place.

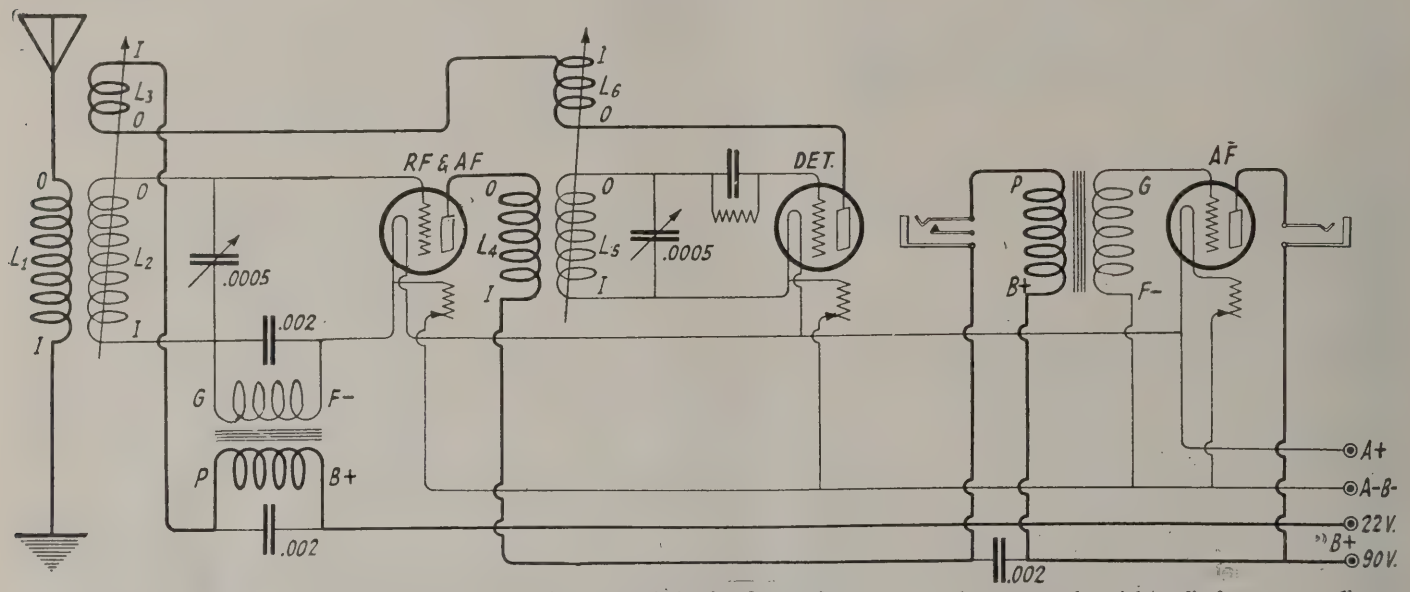


Figure 2—The circuit for the three-tube double regenerative set. This is the same as figure 1 except that a stage of straight audio frequency amplification is added

THE OPERATING DETAILS

After the wiring has been completed go over your diagram and check it several times to make sure that you have made no mistakes. This is not a complicated hook-up, but a slight error in the connections will render it inoperative. Turn the filaments to the proper brilliancy by means of the Fil-Ko-Stat and slowly turn the two variable condenser knobs until a signal is heard. The readings on the two condenser dials should be approximately the same, that is, if you receive a station at 20 in the right hand condenser dial, the left hand condenser dial should read approximately the same. Now, with the left hand tickler coil set at 0 tune in your signal and slowly bring up the tickler coil in your detector tube which is controlled by the extreme right hand dial. The familiar hissing noise denoting regeneration will be reached shortly. The setting on this dial should be left just short of the oscillating point. Now, retune condenser No. 1 and No. 2 for resonance with the incoming signal and slowly bring up the extreme left hand dial which controls the amount of feedback on the first tube. A slight readjustment of condenser No. 1, and a slight lessening of the tickler coil on the detector tube will perhaps be necessary. After short practice the approximate settings for L3 and L6 will be found without difficulty. The two condenser dials can now be calibrated for the exact wavelength of the station and the same station brought in time after time at the same reading on the dials.

For general work this will be found a very satisfactory receiver, and a very sensitive one, but also it is incredibly sharp and great care in tuning must be used at the start. If the first tube, that is the radio-frequency tube, oscillates of its own accord with both tickler coils set at zero, then several turns should be removed from the primary winding of the second tuning unit. Although the diagram shows two rheostats, one on each tube, only one will be found necessary providing the tubes do not differ much in characteristics.

The D-Coil Receiver

So many letters have reached us dealing with the D-Coil Receiver described in the June issue of WIRELESS AGE that our technical staff in co-operation with Mr. McIlvain, the inventor of the D-Coil Receiver, have prepared another article on the set which will appear in October. Certain modifications have been made so that now we have a two-control D-Coil Set incorporating the astatic principle. Some of our readers' enthusiastic comments will also appear, and you will enjoy reading all about this wonderful receiver in the

OCTOBER WIRELESS AGE

The Variety and Significance of Broadcast Programs

George Osborn's Nicollet Hotel Orchestra

Second Thoughts of a Listener-in

BROADCASTING education has been a matter of vital concern to educators throughout the country. The possibilities of education by radio have been recognized, but have not been measured. Decisive steps have been taken in several quarters to determine the method as well as the proper curriculum for effective teaching through this new medium.

Station WBZ was quick to grasp the trend in this direction. Several extension courses were tried and found to be entirely practicable. Their latest contribution in this has been the Musical Appreciation course in co-operation with the Massachusetts University Extension.

A feature of the course was the use of actual examples for the lectures. The radio students taking the course were not only told about the different forms of music with explanations of their characteristics, but actually heard the music by way of illustrating such points.

Professor Olmsted was chosen to present the course. He is Professor of Vocal Music at Smith College, Northampton, Mass., and conducts a studio of vocal teaching in New York City.

After graduation from Amherst in 1893, Professor Olmsted attended the Metropolitan College of Music where he received a certificate in 1896. From 1894 until 1900, he studied harmony, counterpoint, theory and composition with Harry Rowe Shelly. During this same period, he studied voice with E. H. Anderson, F. W. Packard and H. W. Greene. In 1913 he went to Paris and studied with Madame de Latire and during the next year he was with George Hamlin and Coenrad Brothers. Later he continued his musical work with G. Wilym Miles.

It is only natural that with such a background of musical education that Professor Olmsted should be a successful teacher of music and voice. In fact, he has obtained much note throughout the East for his teachings.

One dollar was charged to those wishing to participate. Each student received printed information on the subject. This assisted the student in being able to differentiate between the various types of music heard over the radio. The money received was given to the instructor for his time and effort spent in preparing and presenting the course, and defrayed the expense of sending the suitable papers on the subject to the enrolled members of the radio student body.

The first course that Professor Olmsted gave, considered in general the self expression of music, the dance instinct, and the song instinct. In his second lecture he considered the ancient and modern dance music. Following lectures treated with the subject of program music, the music of the theater, sacred music, patriotism and its expression, musical forms, and the greatest songs.

This is an example of just what can be done in broadcasting instruction and information. The New York City Board of Education broadcast programs from WJZ. Columbia University also broadcast extension courses through that station. Nightly courses in agriculture were broadcast by the Kansas State Agricultural College. Other agricultural colleges and universities broadcast extension courses in the same manner. In most cases, institutions broadcasting educational courses found them most effective when conducted in a similar fashion to the Musical Appreciation broadcast from WBZ.

One of the latest innovations in broadcast education has been instigated in Oakland, California. The mothers are "going to school" with their children by radio. While engaged in the home duties, the mothers have listened in on the KGO morning educational programs broadcast Tuesdays and Thursdays at 10:20 A. M.

The experiments were conducted by the Oakland Public Schools with the

Above: Carson Robinson, "Eveready Jay Bird" and two-tone whistler. Right: "Little Ahaspa," a Navajo maiden listening-in on the brink of the Grand Canyon, Ariz.

purpose in view of instructing hundreds of teachers and assembled classes scattered over a wide area. One speaker can thus inspire many thousands in city and country.

The program of each broadcast comes under the supervision of a special committee working under the personal direction of Dr. Virgil Dickson of the Oakland Public Schools.

This system has proved so successful, it has been contemplated for continuance this coming school year. One feature alone is a strong argument in favor of such teaching. The mothers, who in the past have found it difficult to follow closely their children's early development, can now tune in on the studies that mould young minds for future citizenship. Likewise, mothers may go to school with their children in other cities where public schools have entered the curriculum. New York City is another notable example.

In a later issue, the progress of broadcast educational programs will be considered at greater length. THE WIRELESS AGE considers this to be a most important phase of radio development.

THE farmers of this country have turned to radio for the many things enjoyed by city dwellers. Tempered by the restful, homestead atmosphere, these pleasures of the city lose the nerve-racking disadvantages encountered in congested districts. Nurtured in the barren quiet of rural sections, the farmers' minds have become thoroughly receptive. But receptive only to information and entertainment. The farmers do not want the city man to presume upon their sphere. In short, they do not want an "outsider" to tell them what, and what not, to do.

Some stations now broadcast live stock, grain and general market reports. These combined with weather reports serve the farmer much as the stock ticker serves the broker.

A striking example of the service thus rendered was disclosed at KDKA. Among other reports broadcast, a government report of live hog shipments was given in detail, including the estimated receipts for the following day's market sales. The government figures, however, were consistently wrong—either above or below the estimated receipts by 10,000 head. An investigation revealed a rather startling, but altogether encouraging condition that had developed. The farmers listened in on the governmental reports, made notes of the estimated receipts for the following day, and then arose at 3:00 A. M. to haul their hogs to market if a shortage was reported. On the other hand, if the market was overcrowded, and prices down, the farmers who had received the broadcast reports would not unload on the market until the prices were up. The result was a strong tendency toward market stabilization.

That is a typical example of just what radio means to the farmer today; the day of keen competition, and the greater need for a more equitable distribution.

In the West, the Farmers' Union functions as a strong co-operative marketing and buying organization. The American Farm Bureau Federation, in Chicago, operates as a political organization. And in the East, the National Grange Association, the oldest of the three, has a social and fraternal objective. These three organizations, all powerful, are not friendly. There are many other farmers' organizations, all unfriendly, each to the other. It is, therefore, essential that extreme care be exercised when any one of them broadcasts a program, whether it be instruction, information, or entertainment. A National Granger, in the East, would very likely take exception to anything broadcast, for example, by the American Farm Bureau Federation in Chicago.

The farm journals encourage broadcasting market reports. A periodical publication cannot serve the farmer as radio does. Reports would be a thing of the past, one week late. But the farm publications can follow the broadcasting with a digest of all that has been broadcast. This is a real service. More because market and weather reports can be supplemented with further information of a pertinent character, following, as it does, the timely service of first importance.

To radio has fallen the distinction of being the one great vehicle by which the city dwellers, for long the beneficiaries of rural development, can repay the farmers with the things both like, but the one only, has been able to enjoy in the past. There is a great deal to be done for the farmers, and should be done as a matter of discharging obligations of long standing. It will be done through broadcast stations.

Broadcast Bits

IN looking over the broadcast news, a variety of unusual features may be discovered in nearly any section of the country. The versatility of radio becomes apparent at a glance.

Motion picture news reels are as keen for news as newspapers. Harry Birch, one of the oldest news reel cameramen in the business, carries a portable receiver with him, which he uses constantly for tips on camera-news. Tuning in station KYW is but a moment's work. Listening to the day's news requires but a few more moments. Then for the picture. Wherever he happens to be, his next job is a simple matter. Tuning in on broadcast news has provided him with information at any point, and at all times, affording him a greater range for seeking photographs — the time employed to some purpose that would otherwise be wasted by sitting around the home office waiting for a lead.

The Winnipeg Board of Trade, realizing the value of broadcast reports, delivers facts concerning the city and the province direct to their citizens through station CKY. Incidentally,

they broadcast information dealing with some thirty-five different topics of interest to tourists and prospective settlers. This is not original, but it does mark the increase of civic confidence in radio.

Radio waves, once started, recognize no barriers. They carry their message to mountain tops and to the depths of mines. When the giant United States navy dirigible, the *Shenandoah,* passed over Schenectady recently at a height of 3,000 feet, WGY exchanged telephonic messages with Lieut. Commander Lansdowne and weather forecasts were transmitted to the dirigible. R. Raven Hart, an engineer, reported reception of WGY's signals at Puento del Inca, one of the highest points on the Andes in Argentina, a distance of 5,200 miles from Schenectady.

C. H. Ingels, a construction engineer, reported reception of KGO, the Pacific Coast station, at Hermit Camp, in the Grand Canyon, 3,300 feet below the rim.

In a test recently conducted by officials of a Scranton, Pa., coal mine, signals from WGY were received at the lowest level of the mine, 480 feet beneath the surface, and a half-mile from the foot of the shaft. The experiment with radio in the mine was carried on chiefly to test the extent to which radio may be utilized for the preservation of miners' lives.

The Canadian National Railways has its parlor and club cars equipped with radio receiving sets of selectivity and patrons of this railroad are regular correspondents of Station WBZ. Almost daily acknowledgments are received from travelers en route who enjoy the nightly entertainments.

Dropping down to the bottom of the sea is a remarkable broadcast feat, but one that somehow seems to be merely another incident in the sequence of events.

C. O. Jackson, a deep sea diver, dropped over the side of a boat to the floor of the Atlantic Ocean. In his diving helmet, he had a special radio microphone, connected by lead cable to the boat and from there to the remote control station of WIP at Atlantic City.

From his point of vantage, Mr. Jackson described the strange fish and other sea creatures living at the bottom of the ocean. The appearance of the sub-sea foliage and mineral formations was broadcast in full detail.

Tom-tom Jazz

FROM out where tom-toms, war-clubs and wails of dancing natives is a part of the daily grind, word has come to KGO, the General Electric Pacific Coast Broadcasting Station, that radio jazz music heard by South Sea native chiefs and their people is appreciated and awakens primitive rhythmic instincts.

"Concerts given by KGO are enjoyed here," writes W. R. Ragsdale, trader at Savaii, the last primitive island of Polnesia.

"The jazz dance music from the Hotel St. Francis is great and is very much appreciated by the natives who listen in regularly over the loud speaker."

That the tribal tom-tom has lost any of its appeal is not evident by the report, but modern jazz is influencing native music in South Seas. Through Ragsdale the chiefs of several different tribes sent their applause to the jazz dance orchestra leader.

Above: Janet Velie in the new revue "Round the Town," broadcast from WOR. Left: Baby Peggy, movie star, also did some broadcasting recently

Listeners in New Zealand over a thousand miles further south report that they do not hear music there like the jazz heard over KGO. Members of the Australian Radio Relay League are reporting that this station is being heard in New South Wales, a distance of over seven thousand miles.

The Turf Radioed

SPORTS in radio has just had its greatest broadcast season. The following is a paragraph clipped from the sport page of the *New York Bulletin.*

> "The radio is hurting the fight game too. There's a fellow sending out radio descriptions who is a corker. If you sit at home and tune in and hear him tell about the fight you get a bigger thrill than you do if you pay down your good coin. He makes the fights interesting, whether or not they are—and when the judge's decision is bad he broadcasts that fact, too. I understand the boxing commission took him to task one day for expressing his opinion to the million invisible fans and he laughed at them, as he should. He only was voicing the opinion of most men who have been attending bouts the past year or two."

This reflects rather pointedly the viewpoint of newspaper sport writers.

From fights to racing is only a matter of twirling the dial. For the first time, since horse-racing became a favorite sport, track enthusiasts will be able to follow the progress of the horses during the forthcoming International Races at Belmont Park and Aqueduct on September 4th and 27th. Through the co-operation of Major August Belmont, and the Westchester Racing Association, Station WJZ of the Radio Corporation of America will broadcast running descriptions of both races.

These International Races, which are the result of the interest and enthusiasm aroused in racing circles both here and abroad by the Zev-Papyrus race last year, have aroused even more attention than did the former match, for Epinard is profiting greatly by the example of Papyrus. He arrived in time for a much longer training period here, allowing him to become completely familiar with our tracks, and is being handled by Jasper Leigh, a former American horseman who knows our methods of racing thoroughly. The three races which have been scheduled will allow the visitor to display his form at a variety of distances and over three different tracks.

—W. A. H.

The Yacht *Ara's* Complete Radio Outfit

Spark and tube transmitters, a direction finder, a four-element tube receiver, and loud speakers in the staterooms completes the radio installation on W. K. Vanderbilt's yacht which is about to cruise the Mediterranean

By Steffen F. Nielssen

"THE CRUISE OF THE ARA" in the June issue of THE WIRELESS AGE brought forth various inquiries as to the type of radio equipment used in accomplishing the unusual work done in handling traffic and supplying entertainment and news to those aboard the *Ara,* in addition to the work done with the direction finder as an aid to navigation. To satisfy the interest displayed by the readers of THE WIRELESS AGE a description of the station seems fitting.

The apparatus aboard the *Ara* was installed by the English Marconi Co., and is a duplicate of that aboard the *Majestic* of the White Star Line. In some respects it differs from the American type of apparatus and it is for that reason a complete description should prove interesting to American readers.

Three separate transmitters are installed on the *Ara,* one 1½ kw. tube transmitter, one 1½ kw. spark transmitter of the quenched type (500 cycles) and one smaller spark transmitter rated at ¼ to ½ kw. intended for emergency use, or for low power transmission.

The C.W. transmitter—shown on the left in figure 1—is rather small in size considering the output, but nevertheless it is capable of doing some good work, which is probably due to the efficient tubes that are used. The same set is used on nearly all the larger English passenger vessels, including the *Majestic.* It is noted for its pure C.W. note which is secured by means of perfect rectification.

The larger tube in the center is the oscillator and the two smaller tubes, the rectifiers. It will be noted on the top panel there are two rows of holes into which a plug is inserted. The top row taps are connected to the antenna inductance and by plugging in the different sockets any wavelength between 1500 to 3500 meters can be obtained on an average size aerial. The steps between the various taps are filled in by means of a variometer which is mounted on one end of the aerial inductance, placed directly behind the top panel. The handle to the right of the top panel is connected to this variometer. The reaction coil is mounted at the left-hand end of the top panel and a small condenser is connected in parallel with the reaction coil. The lower row of tappings are connected to the A.T.I. through a condenser, called the feed condenser, by means of the plug attached and thence to the plate. Different power is obtained by inserting the plug in the various sockets, but usually there is one place where the set oscillates best and once found, that value should not be changed, except for obvious reasons such as increasing the power.

Below the three tubes are mounted three ammeters which show the current through the filament of the transmitting tube, the high tension supply to the oscillator and the aerial current respectively. The meter on the left-hand side is the ammeter showing the filament current of the oscillator. In the middle is the milliammeter showing the plate current and on the extreme right the aerial ammeter.

At the bottom of the panel will be seen two handles protruding, they are connected to two adjustable iron cores which regulate the values of the chokes in the filament circuits of the tubes. By the use of these chokes the filaments can be kept burning absolutely steady whether the key is closed or open, and that accounts for the steady note produced by these sets. At the extreme left on the bottom panel is the rheostat for the oscillator filament and on the right-hand end a push-button, which when pressed discharges the smoothing condenser, thereby rendering the set harmless in case any repairs have to be made. This smoothing condenser, being highly insulated, is capable of retaining its charge for several days and if not discharged will give a most unpleasant shock. All other apparatus such as grid leak condensers and radio-frequency choke, etc. are mounted back of the panel. A grid leak of 30,000 ohms is used. It is wound on mica sheets in several sections all connected in series making it possible to replace one or more sections in case of a burn-out.

One peculiarity of the English tubes is that the filaments must never be burned below a certain brilliancy, but rather a little above the specified brilliancy or the tubes are certain to be damaged, quite contrary to the American tubes, where it is of importance to burn the filaments as low as possible. Burning these tubes below normal brilliancy will not only damage the vacuum, but also the life of the filaments.

TUBE TRANSMITTER

The transmitting key has two extra pairs of back contacts mounted. One pair is in series with the compensating choke and the primary of the transformer. They short-circuit this choke when the key is closed, thereby allowing for the drop in voltage. The second pair of contacts is arranged so that when the key is not pressed there is a break in the grid circuit, which is closed when the key is pressed. The object of this arrangement is to sharpen the telegraphing. If the grid circuit was left closed all the time the set would continue to oscillate after the key was released due to the electrical energy stored in the smoothing condensers, but by breaking the grid circuit the oscillations are stopped instantaneously.

Above the C. W. transmitter will be seen a wavemeter used to adjust the transmitter for the different wavelengths. A small tube lights up when the set is in tune with the wavemeter.

This set on full power puts 750 watts into the antenna, the plate being cool. Only 65 milliamperes are consumed by the plate owing to the extremely high plate voltage used.

SPARK TRANSMITTER

The main spark transmitter will be seen to the right of figure 1. It is of the quenched gap (500 cycle) type and is rated at 1½ kw. It differs chiefly from the American set by its use of a fixed coupling, that is the coupling can be changed by a system of taps and not by sliding of the inductance, as is usual

with the American sets. This coupling is quite critical and for best quenching a coupling of seventeen per cent. has been found best for these sets. They are very rugged, and there are no adjustments to be made after the set is once adjusted. To change the wavelength it is merely necessary to place the switch handle on the wavelength desired.

The quenched gap differs somewhat from the American gap as the discharge surfaces are exposed to the air and the discharge is in plain sight. When the gap is working properly an even stream of fire takes place all the way around and practically without any noise at all. The action of the gap depends largely upon the right per cent. of coupling. The gap is well made; heavy silver surfaces being used for the spark to discharge between. Chokes, condensers, etc. are mounted back of the panel. On the lower part of the panel will be found a small switch used for the 300-meter wave only. Normally this switch is kept closed, thereby short-circuiting the short-wave condenser. To the right is mounted the aerial ammeter above which is also mounted a small switch for the purpose of protecting the ammeter when not in use.

Above the main transmitter in figure 1 will be seen the emergency ¼ to ½ kw. spark transmitter which is also of the quenched type. It is constructed for practical work like the larger set. A small motor generator driven by storage cells furnishes the power. It has a piercing note—800 cycles being the frequency used—and this high-pitched note will often carry through interference where the lower frequency fails. On its rather small but efficient aerial, a double cage with twelve No. 18 bronze wires in each cage, the C.W. set radiates on ¾ power 10 amps., the spark set 15 amps. and the emergency 6 amps.

The same motor generator and power transformer is used for both the tube transmitter and the main spark transmitter, but when using the C.W. set, the primaries of the transformer are connected in parallel and the center point of the secondaries connected to earth. When using the spark set the primaries are connected in series and the secondaries are clear from the earth. A transfer switch performs these changes automatically.

The aerial change-over switch used for connecting either the tube or spark set to the aerial is so arranged that power cannot be supplied to the tubes unless the filaments are properly burning, thereby preventing damage to the tubes.

The send-receive switch is conveniently located on the right end of the operating table and a short side motion connects either aerial to transmitters or to receiving instruments. This switch breaks both sides of the A.C. mains and also short-circuits the receiving instruments while transmitting.

The switchboard located to the extreme right carries all the control switches for the main set and emergency power besides providing means for charging the storage batteries. Two large Edison storage batteries are used for lighting the filaments and special English made "B" batteries, of the lead cell type, are used.

Receiving Apparatus

Two receiving instruments are used. They are located next to the spark transmitter.

At the top of the instruments is a three-step power amplifier used in connection with broadcast music. Immediately below is a very efficient three-circuit tuner used mostly for copying press as it is more selective than the universal receiver mounted just below. With this receiver, although small in size, it is possible to receive over a range of from 300 meters to 24,000 meters. It is designed to receive through the transmitting inductances, under which condition the aerial side will already be tuned to the desired wavelengths, according to which side the transfer switch is placed. Inside the receiver there are a number of inductances, which can be connected into the circuit by means of a number of switch levers seen mounted on the front panel. Two variable air condensers are used for tuning the aerial and the secondary circuits. Switches are also provided by which the aerial condenser can be placed either in series or in parallel according to the wavelength, and for long waves a fixed condenser is connected across the secondary condenser. In the middle of the panel is located the coupling coil which controls the degree of coupling between the primary and secondary circuits.

Below the Marine receiver, two other instruments will be seen, the one

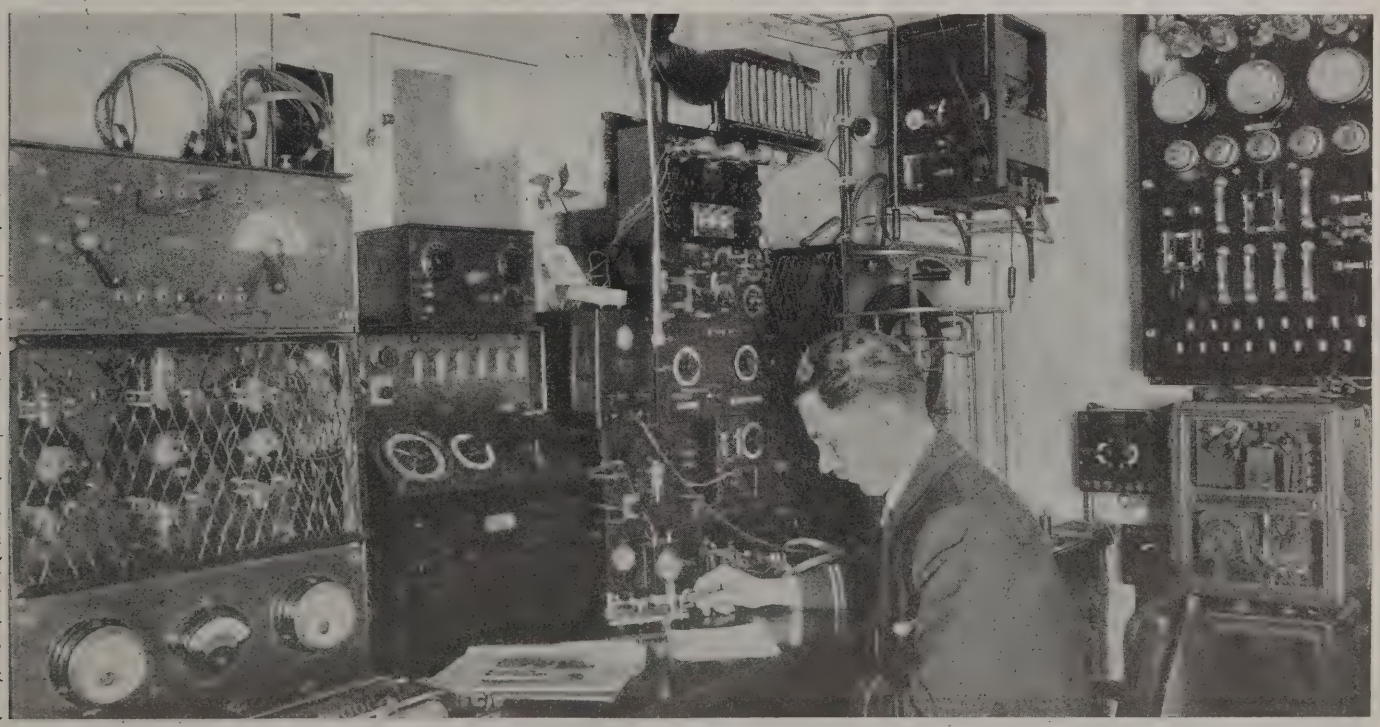


Figure 1—Left to right is the C. W. transmitter, the direction finder and gyroscopic compass, the two receiving sets and loud speaker (above) and the main spark transmitter (partly hidden by the operator's head). Above the main transmitter is the emergency spark transmitter and to the extreme right is the switchboard, and below, the motor-generator starter

to the right is the local oscillator which produces local oscillations for the purpose of receiving continuous waves by the beat method. It is arranged so that the strength of the oscillations produced in the receiving instruments can be varied at will, through an adjustable coupling. Eight different inductances are provided to cover all the wavelengths and they are connected into the circuit by means of a multi-point switch of the anti-capacity type. Louder signals are the result, when using a local oscillator as the receiving instruments are thus tuned to exact resonance with the incoming signal and the selectivity is improved. It can also be used to advantage when receiving weak spark signals though the musical note is spoiled. The oscillating tube (V-24) is mounted on the front panel. Just below the tube is the graduated knob for varying the coupling. To the left end is the amplifier designed to be used with the Marine receiver, but it works very good on any other set. This amplifier differs from any American amplifier in that it employs a "four electrode" tube which results in economy in tubes and filament current. Three actions are carried out simultaneously by this four electrode tube, viz: high frequency amplification, rectification and low frequency amplification. This tube makes use of two grids, the usual plate and filament. High frequency amplification takes place between the filament, inner grid, and outer grid (the outer grid being connected to the "B" battery), in the same manner as the ordinary three electrode valve.

By referring to figure 3, it will be noticed that the radio frequency will flow through the condensers C2 and C3 in preference to the windings T2 and T3. Rectification takes place between the filament and the anode. It will be observed that the transformer T1 performs the duties of the usual radio frequency transformer.

In this circuit the grids play no part in the action of rectification, and there is no high tension. The tension of the anode with respect to the filament is governed by the potentiometer and the maximum available is about three volts positive to the negative end of the filament.

The audio frequency pulsation of rectified current taking place in this circuit will act upon the filament inner grid circuit through the transformer T2 and these audible frequency pulsations will be again amplified between the filament and inner and outer grids and, now being of low frequency, will flow through the winding of T3 instead of through C3. Transformer T3 is an ordinary phone transformer used in connection with low resistance phones. Both the primary and the secondary windings have an equal number of turns. T2 is a closed core audio frequency transformer with an equal number of turns in both windings.

It will be noted that the potentiometer varies the potential of the anode with respect to the filament, and has nothing to do with the grids. Its sole duty is to give selective effects. The slider of the potentiometer ranges only over half of the total resistance, each winding being 110 ohms.

The various transformers (audio and high frequency), condensers, jacks, etc. are mounted inside the amplifier. The high frequency transformer has three windings all in series and the different windings are arranged through a switch to be included in the circuit or shorted out according to the wavelength which it is desired to receive. The audio frequency transformer is of the ordinary kind. The outer grid really performs the usual duties of the plate of a three-electrode tube and the outer sheath which looks like it might be the plate, is only used for rectification. This amplifier works very nicely and gives unusual amplification on all wavelengths, though the amplification falls off somewhat on the extreme long waves.

Above this amplifier there is placed an extra three-stage audio frequency amplifier, but it is seldom used except

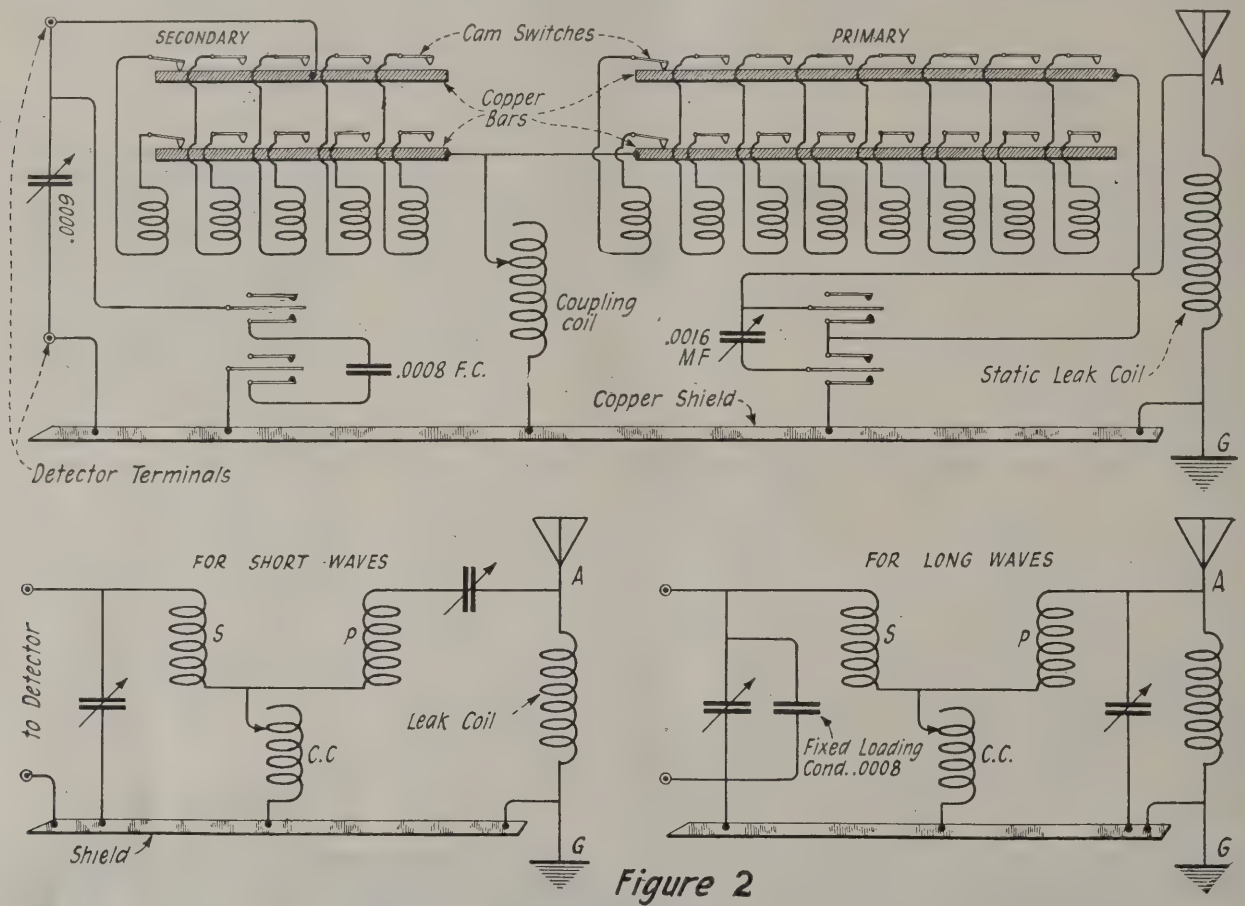


Figure 2

The universal receiver

when receiving very weak signals or music.

To the left of the receiving instruments is mounted the direction finder. This again differs from the usual loop type used in this country, in that it employs two stationary loops generally triangular in shape. One loop is mounted exactly fore-and-aft and the other athwartship; in other words each loop is at a right angle to the other. The receiving power of these two loops is made exactly alike by means of two adjustable chokes and they are connected through a magnetic switch to a goniometer. The purpose of this switch is to prevent damage through induction to the delicate amplifier, when the transmitter is in operation, so when the direction finder is not in use it is automatically grounded. The goniometer is connected to a four-stage radio frequency amplifier after which the signal is rectified. There is also provided one stage of audio frequency amplification which can be switched in or out at will. Next to the direction finder is placed a "repeater," which is part of the gyroscopic compass installed on the yacht. The purpose of having the repeater in the wireless room is that better bearings can be obtained and at the same time the finished bearing is delivered to the bridge. Were it not for the repeater, one of the mates would have to stand by at the compass while bearings are being taken and the bearing computed in the chartroom. As there is no magnetic error to the gyroscopic compass it is really very simple to take a bearing and the most essential thing for obtaining accurate bearings is speed, so as to obtain two or more bearings from the same station, if possible, while it is working. If it is desired to take a bearing it is only necessary to throw certain switches whereby the direction finder is ready for use. Having picked out the station whose direction is required (which is done by turning of the tuning condenser), the switch to the left is placed in the middle position, thereby bringing the goniometer into action. It will then be noticed that signals rise and fall as the pointer of the goniometer is moved over the scale. The attention must now be fixed on two signals of equal strength on each side of the zero point and their readings noticed. At the same time the reading of the repeater must be read. The mean of the two readings on the goniometer scale will be the required direction, it is then merely necessary to add the number of degrees obtained from the repeater when the bearing was taken, to the goniometer reading, which gives the complete bearing. The loops are adjusted by means of calibrated chokes placed inside the cabinet and once they are properly adjusted there is little chance of error in the bearing obtained. Bearings as far as 200 miles have been obtained with not more than one degree error, but the instrument is only intended for ranges up to 50 miles or so, the range depending somewhat on the strength and sharpness of the received signal. The direction finder is also very useful for receiving through heavy interference by taking advantage of its directional qualities.

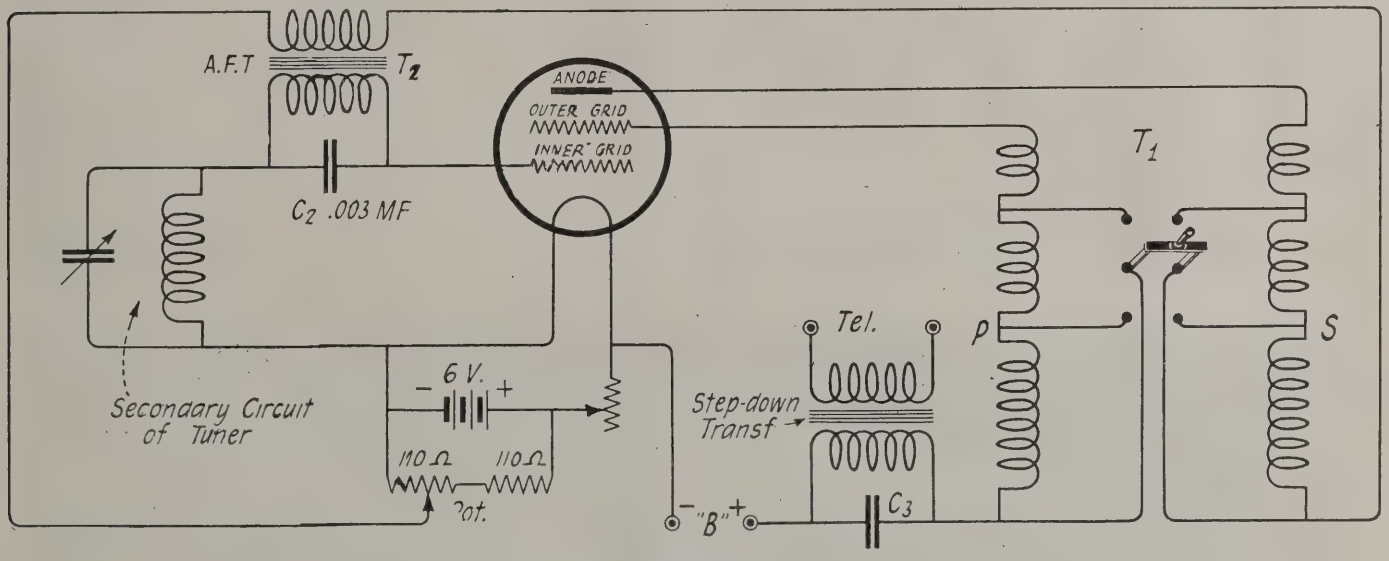
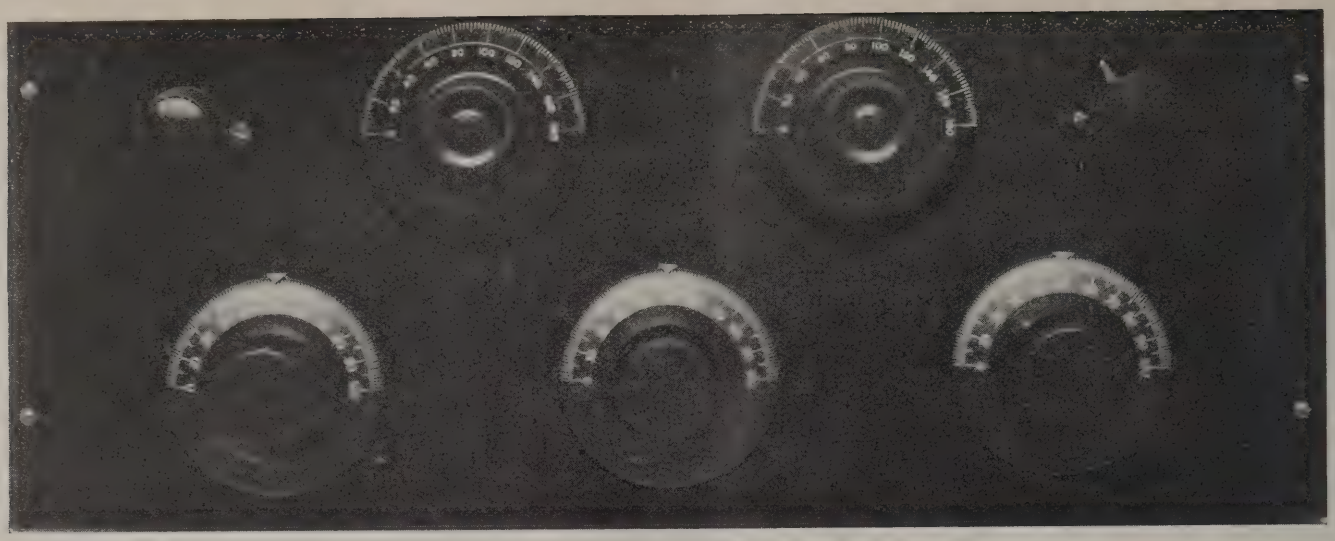


Figure 3

Four-electrode vacuum tube reflex circuit

General Notes

All of the wiring is run in lead-covered cables which in turn are connected to the ground at frequent intervals. The ground connections, two being used, are obtained by screwing large copper studs into the hull of the vessel. A separate ground is employed for the direction finder. Perhaps many would like to know what the range of this installation is. It is not easy to answer that question, as it depends on so many things, such as favorable atmospheric conditions, the size and height of the aerial, etc., but its average daylight range on C.W. is well over 1600 miles, and on spark 300 miles during the day. The above mentioned distances are based on actual work accomplished during our last trip south and under unfavorable atmospheric conditions most of the time. The small emergency set is good for 125 miles daylight range any time. The good results obtained with this set, considering the rather small aerial, are largely due to the high efficiency of the aerial, porcelain insulation being used throughout. The motor-generator, being of the inductor type, there are no A.C. brushes and no moving windings. It is placed in a "silence" cabinet as is also the power transformer and transformer switch, the latter having a handle attached to it protruding through the cabinet within easy reach of the operator. The alternator is wound so as to be suitable for both spark and C.W. and as a result, the armature reaction is rather heavy. When using C.W. a small condenser is placed across the high tension terminals to improve the power factor and so steady the volts. The power regulator, only used on C.W. is also placed in the silence cabinet with a regulating handle attached thereto and extending through the cabinet. The automatic starters and regulators are mounted on the bulkhead. When it is desired to listen to radio broadcast music, it is only necessary to throw a switch thereby connecting the yacht's music room with the receiving instruments, it being wired for that purpose, with sockets mounted out of sight, into which loudspeakers may be plugged.



Oscillation Controlled R. F. Receiver

Try your skill in tuning in stations. A set that gets long distance and is remarkable for its clear amplification

By ROBERT ALAN

DESPITE the fact that this receiver has five dials on its impressive-looking panel, it is not as formidable as it appears and is a sensitive, easily tuned receiver. It tunes quite like any tuned radio frequency set—there being three dials which should read approximately the same. The other two dials are merely balancing condensers in a trap circuit which control the tendency to oscillate. It's a corker for you DX-hunting people and it will make use of every bit of tuning ability which you possess in order to get the zenith of reception. But do not misunderstand—without any previous experience any one can tune it for ordinary reception of distant stations by following the calibrations of a previous tuning. The operation is as follows: The three lower dials are tuned to resonance with the incoming signal. The set will probably oscillate at this point. Now the secret of this efficient receiver is disclosed. The two upper dials control two small three-plate variable condensers. These two condensers are adjusted so that they overcome and render negligible the internal capacitative feedback of the tubes and as a consequence prevent the receiver from oscillating. By a further adjustment of these condensers a fine degree of regeneration may be had and just enough feedback take place to greatly amplify the signal over the ordinary transformer amplification. Thus, it will be seen that the peak of radio frequency amplification is attained in this type of set.

The dials once calibrated and set at previously determined numbers will always bring in a given station at the same reading. We refer you to the "Information Desk" for July for full instructions on the calibration of a receiver.

Construction Details

In assembling the parts for this oscillation-controlled radio frequency circuit first mount the aluminum frames on the panel at each end, allowing the top of the frames to come flush with the top of the panel. This will leave approximately 5/8 of an inch at the bottom of the panel which will nicely include the thickness of the baseboard. Before fastening the panel and aluminum frames to the baseboard mount all the instruments on the panel. The three National vernier variable condensers are not mounted in the usual fashion. The dial is taken apart and the thin metal framework behind the dial is fastened to the panel and then the condenser in turn fastened to this. Then the dial is centered properly and fastened to the shaft of the condenser. Draw a line on the panel five inches from the top and parallel to it. This forms a center line for the variable condensers. Along this line mark off points three and five-eighths inches, nine inches and fourteen and three-eighths inches from the left-hand edge of the panel. These will be the center holes for the shaft of each condenser. Then one and a half inches from the top of the panel draw a line parallel to the top of the panel and mark off points six and three-eighths inches from each end, also on this line mark off a point two and five-eighths inches from the right-hand end. This is the center hole for the Paragon stage switch. The use of this switch obviates the use and troubles of jack connections. It can be thrown from off position to first stage, second stage and detector with the phones plugged in the one jack.

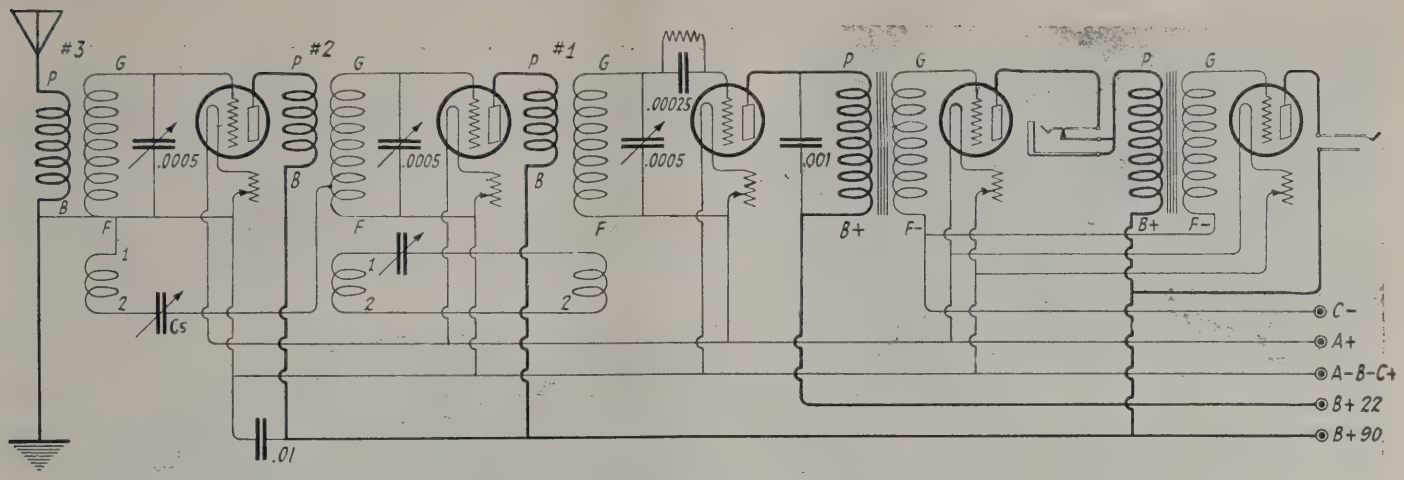
Two and five-eighths inches from the left-hand end and along this same line drill a hole for the Fil-Ko-Stat which controls the filament current on the detector tube. This completes the drilling of the panel. The two radio

LIST OF MATERIALS

Three National Vernier .0005 mfd. variable condensers.
Five Na-ald standard sockets.
Two Paragon audio frequency transformers.
Two Duplex three-plate variable condensers.
One Fil-Ko-Stat.
Four Amperites for UV-201A's.
Nine Eby binding posts.
One Kellogg double circuit jack.
One Paragon stage control switch.
Spool of No. 20 D.S.C. wire.
Ten lengths of Essex Skwareflex.
One Set of Bremer-Tully radio frequency transformers No. 1, No. 2 and No. 3.
One Mica grid condenser and leak.
One .01 mfd, fixed condenser.
One 7" x 18" panel.
One Dubilier .001 fixed condenser.
One Baseboard 12 x 18 x 5/8 inches.
One Hard rubber binding post strip 2 x 18 inches.
Two Quinby aluminum frames.

ACCESSORIES

One 6-volt 100-ampere-hour storage battery.
Five UV-201A's or five C-301A's.
One set of head phones.
One loud speaker.
Ninety Volts of "B" battery.



Circuit diagram of the oscillation controlled receiver

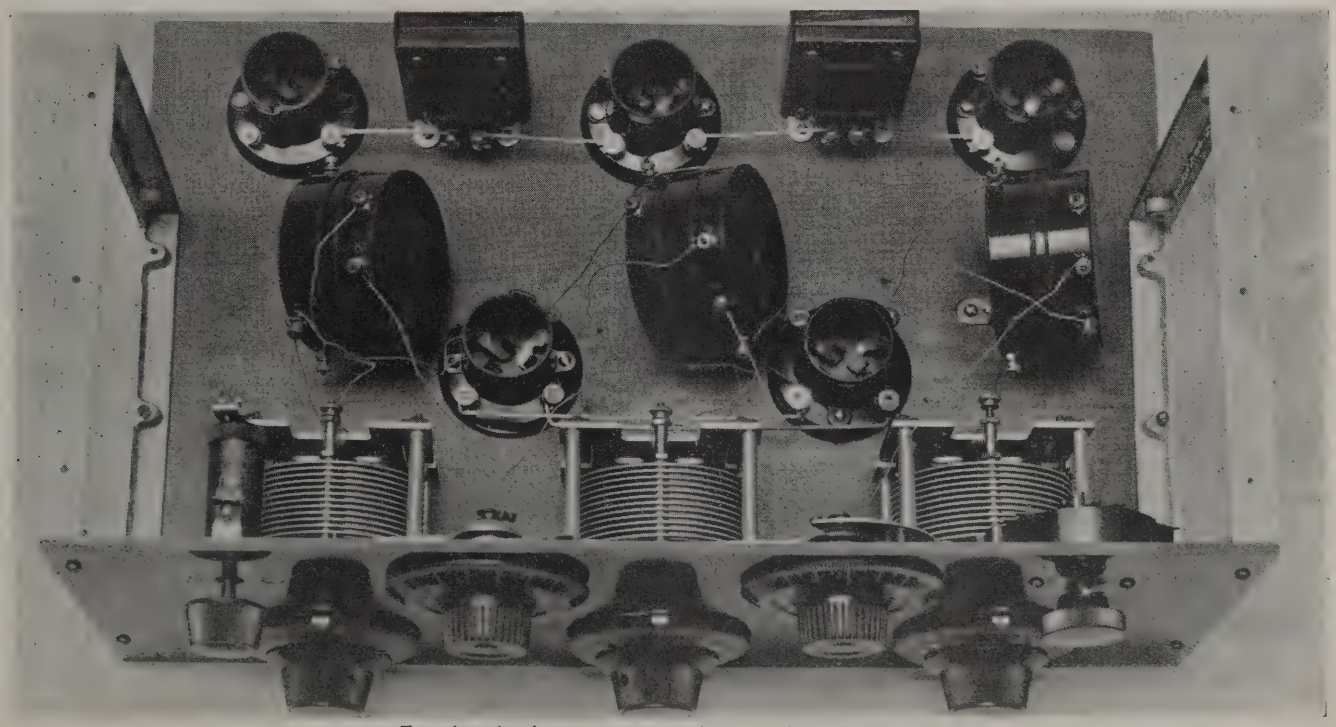
frequency tube sockets are mounted directly behind the variable condensers on the baseboard and each socket placed between two condensers. The Bremer-Tully transformers Nos. 1, 2 and 3 are mounted between these sockets, so that the order from left to right is No. 3 transformer, a tube socket, No. 2 transformer, another tube socket and No. 1 transformer.

The detector and two stages of audio frequency amplification are placed in a straight line at the rear of the baseboard. They are placed in reverse order. That is the detector is on the right hand and nearest the output of the second stage of radio frequency, then follows an audio frequency tranmsformer, a tube socket, another transformer and the last tube socket. Do not attempt to make all the connections with bus wire as this will present a very troublesome job and will be extremely awkward to handle. The connections from the radio frequency transformers should all be made with No. 20 or No. 22 wire because it is necessary to adjust the position of the transformers when you come to actually operate the set. The connections on the A.F. amplifier, of course, can be of bus wire and likewise the filament connections on the R.F.

The Operation

It is well to read these instructions thoroughly before starting work on this elaborate tuner. Remember that a radio set is a delicate piece of apparatus and that small things that may not impress you as worthy of notice may be of the most vital importance. This circuit has been developed with the object of combining into one circuit the greatest possible range, selectivity, and clearness of signals together with ease of control and simplicity. Like all other circuits of any merit it will repay him who makes use of skill and experience and care in operation. The operator who desires to use his utmost skill in tuning will find that the balancing controls, that is the two 3-plate variable condensers afford great possibilities in the amplification of weak signals, because the radio frequency amplifier can be brought to the point of regeneration or maximum amplification of signals and past this by means of two small variable condensers. This permits a maximum amplification throughout the wavelength range. The dial settings will be consistent for all stations and a given station can be depended upon to come in on the same spot on the dial time after time. The two 3-plate condensers can be adjusted permanently for all ordinary reception, but may be used also in bringing up volume on distant stations to a remarkable extent. Be careful to follow the

(*Turn to page 78*)



Top view showing mountings on front panel and baseboard

World Wide News

The transmitting and receiving end of the railway radio broadcasting station 6ZZ, on train running between Scotland and England

New South American Plans—Japanese Broadcast Regulations—Soviet's Radio Plans—British Beam Station—Brazilians Use Radio to Conquer Rebels—Presidential Campaign

By C. S. ANDERSON

Managing Editor of WIRELESS AGE

New South American Radio Plans

THE adoption of an entirely new and extensive program for the promotion of radio broadcasting in Latin America by American interests following the abrogation of an agreement under which the American companies had jointly participated in the South American radio business for the past three years with interests of England, France and Germany, has been announced by General J. G. Harbord, president of the Radio Corporation of America, who said the new plans gave the United States its first unrestricted opportunity to utilize fully its resources in developing radio in South America. Five of the principal countries of the continent, Argentina, Uruguay, Chile, Venezuela and Brazil will benefit by the new plan.

The program not only includes a change in the system of distributing merchandise, which enables the American company to direct its radio activities with far greater efficiency than the previously existing arrangements had permitted, but it involves in addition the introduction of a practical method for the support of broadcasting which will be first applied, as a trial, to the powerful broadcasting station located at Buenos Aires, Argentina.

General Harbord explained that negotiations with other radio companies in South America had been in progress for several months, the outcome of which was the dissolution of the original local organization known as Radio Sud America. He pointed out that one radio company in England, France and Germany together with the Radio Corporation of America had originally formed this organization as the sole distributing agency for the sale of radio apparatus of English, French, German and American manufacture, but this arrangement did not prove sufficiently flexible to enable the participating members to conduct their individual business on a basis best suited to the technical and commercial development of the art and industry in South America.

"The cancellation of this former agreement marks the beginning of a new era in our South American radio activities," General Harbord said. "We are now in a position to carry the banner of the United States' leadership in radio below the Equator. We have been somewhat retarded in the South American field due to the restrictions imposed by the four-sided compromise which has been in force since the end of the war."

"One of the outstanding advantages of the plan which was made effective following our release from Radio Sud America, is a system giving direct contact with the South America radio market from New York thus eliminating the expense incidental to carrying on operations through intermediate distributing centers. With newly organized outlets forming a part of the distribution circuits, terminating at Buenos Aires, Montevideo, Sao Paulo, Rio de Janeiro, Valparaiso, and other leading cities, every new development in broadcasting apparatus will be made available to South Americans practically simultaneously with their introduction in the United States.

"There is every reason to believe that Latin America will continue to show an increasing interest in radio broadcasting. Particularly is this true now that a way has been devised to give her the advantage of apparatus embodying all the latest improvements contributed by engineers and scientists in the United States. Such cities as Rio de Janeiro, Buenos Aires, Montevideo, Sao Paulo and Valparaiso, and other centers of art and education scattered throughout the republics of Latin America are some of the great reservoirs which broadcasters may tap for a variety of program matter to be

broadcast to millions of homes where the light of radio has not yet entered.

"Unlike North America, distances between cities are greater and a large percentage of the population resides in the vast farming regions. Radio broadcasting must break down these barriers of space which isolate town and village from the cities. Wire facilities, too, are not within as easy reach of the people of South America as they are in this country. Radio broadcasting will do much to supplement existing means of communication such as the telephone and the telegraph."

Japanese Broadcast Regulations

UNDER the recent regulations established in Japan any person desiring to establish a broadcasting station must file an application with the Minister of Communication specifying in the application details of the installation, estimated cost of construction and furnish an estimate of anticipated receipts and disbursements. Two classes of stations are permitted according to range, the long distance range being within 160 kilometers; 360 to 385 meters wavelength and 1.5 kw. power input is reserved for this class. The short range stations operate within a distance of 30 kilometers, using 250 watts input and work on 215 to 235 meters wavelength. The license fee for the long distance station is 500 yen and the short distance class pays 300 yen.

Receiving sets are also licensed and specifications require a fee of 2 yen, examination and approval by the Electric Technical Laboratory, operation on a specified wavelength and notification to the Director of Communication upon disposal of the set.

Soviet's Radio Plans

SOVIET Russia will soon join the United States and other countries in broadcasting news, speeches and entertainment programs to the public, and the Council of Commissioners is expected shortly to issue a decree permitting the installation of receiving sets in the home at a moderate license fee.

The Government will not only allow radio users to construct their own receiving sets, but will undertake itself to manufacture amateur apparatus for Russia's millions. This will require an entirely new industry, and the Government hopes it will stimulate the development of electrical science and provide work for the State factories, which are now running at reduced capacity.

Engineers, electricians and the general public are invited to submit models of home receiving sets. These will be examined by a jury of experts and a prize will be awarded the designer of the one chosen as best adapted for Russian conditions. The Government desires that the cost of a receiving set shall not exceed $15.

Up to the present time the Government has confined the broadcasting of official speeches and similar matter to the various provincial Soviets, branches of the Rosta News Service and Communistic party organizations throughout the country, which embrace more than 300 receiving stations.

There are forty sending stations in Russia, eight of which have a radius of 2,000 miles or more each. The Government is completing a powerful receiving station at Lioubertzy, the site of the International Harvester Company's plant near Moscow, which will be capable of picking up the principal American stations.

British Beam Station

THE British Government will cooperate with the Marconi Company in trying out the new beam system of wireless communication.

The Marconi Company will erect a beam station in Britain adapted for communication with Canada and capable of extension to provide beam communication with South Africa, India and Australia.

New Zealand and India has reported that a station of the new type would not meet their requirements, and India has issued an invitation to an Indian company to erect a high-power station in India.

Australia and South Africa are disposed to allow the beam stations to be erected for communication with Britain, to give the new system a trial.

New Wave for Amateurs

A POSSIBLE solution of the congestion of broadcasting wave lengths is anticipated by radio officials as a result of the action of the Bureau of Navigation at Washington in opening four new bands of short wave lengths to amateurs.

The Bureau of Navigation has authorized all district radio supervisors to issue general and restricted licenses to amateurs to permit the use of the bands 75 to 80 meters, 40 to 43 meters, 20 to 22 meters and 4 to 5 meters for CW purposes. At present the amateurs use the band 150 to 200 meters.

The principal object of the opening of the new bands to amateurs is for experimental purposes.

The members of the Rye Beach, N. H., Coast Guard Station utilize radio for entertainment when not engaged in the excitement of rescue at sea

The nightingale broadcasts her song from the forests of Denmark

Brazilians Use Radio to Conquer Rebels

BY radio broadcasting and propaganda of leaflets dropped from airplanes the Secretary of War of Brazil warned the remaining 300,000 civilians in Sao Paulo to "abandon the city, leaving the rebels to their fate."

The Government of Brazil has definitely decided to use heavy artillery against the rebels of Sao Paulo to a degree not attempted heretofore.

Whether it is intended to add aircraft for bombing operations at the same time is not known here.

The appeal of Marshal Setembrino de Carho, which was broadcast, gave warning that military operations against the rebels will soon assume a more stern character.

Television Possible by Radio

EDOUARD BELIN, of France, has the solution of the problem of television.

This is the instantaneous transmission of vision by one machine to another receiving apparatus which may be coupled with the transmitting machine at a distance.

Such a feat requires emission points at the rate of 300,000 a second, which is impossible over telephone or telegraph wires, but can be accomplished by radio.

Belin says some technical details remain to be worked out and construction of the machinery has to be completed, but he considers there are no great difficulties in the way of perfecting the invention.

Radio for German Trains

THIS autumn German express trains will be equipped with combination radio and wireless telephones, enabling the sending of wireless messages, telephoning and the giving of radio concerts while trains are speeding on their way. The wireless telephones will be attuned with regular telephone systems at receiving stations.

For radio messages special compartments will be built in the trains and transmission stations erected at the principal railway depots.

Fighting Forest Fires By Radio

RADIO is playing an important part in fighting the unprecedented forest fires now raging in California. The worst fires in the history of the Forestry Service are burning there all over the state. Up to the time of the last report 33,000 acres had been burned inside the national forests alone, and forty fires are still burning.

Realizing that the state was facing a grave emergency and one where a holocaust might result, Paul G. Redington, United States District Forester at San Francisco, turned to the radio broadcasting station for assistance. It resulted in an immediate personal appeal to hundreds of thousands of listeners-in.

There was an immediate response to the appeal. First the citizens were acquainted with the dangers threatened by the fires then burning, and told what they might do to help the fire wardens put the burning fires down. As a result of this it is estimated that between 20,000 and 30,000 persons at once came to the rescue.

Of course such warnings as the latter had been sent out almost as long ago as we have had forests, but never before did they get to the people as by means of the radio. Not only citizens responded, but the word was carried forward by Chambers of Commerce, Automobile Associations, Boy Scout patrols, and was so successfully achieved that from now on radio will have a definite part in the fighting of fires in forests and woods.

What this will mean may be judged from the fact that in the California situation alone something like 1,000,000 acres of timber land has been threatened to say nothing of what the fires in Montana and Idaho are putting into jeopardy.

The Forest Service has estimated that within the five years over 160,000 forest fires were reported in this country. These fires swept an area of 56,000,000 acres and destroyed timber and property valued at $85,000,000, exclusive of indirect and intangible damage to young growth, water resources, and recreational facilities.

The Presidential Campaign

POLITICAL speeches by radio during the approaching Presidential campaign, will be short and to the point, according to all indications.

Both the broadcasting companies and the candidates appear to agree on brevity in their orations from the aerial stump.

John W. Davis, Democratic candidate, expressed his view of the matter by quoting an English churchman to the effect that "rarely is a conversion made after the first twenty minutes."

The companies, while agreeing that long speeches will surfeit and alienate their listeners and damage the interests of the candidates, differ somewhat on proposed methods of limiting the addresses.

The American Telephone and Telegraph Company, according to W. E. Harkness, assistant vice president, in charge of Station WEAF, indicates that no arbitrary time length would be stipulated. Instead the speaker would be expected voluntarily to limit the length of his speech.

Officials of the Radio Corporation of America, however, have suggested to the speakers' bureaus of the Democratic and Republican parties the limitation of speeches to fifteen minutes and to a total of one hour a day. They also suggested that the speeches be restricted to national issues.

The modern "hurdy-gurdy" in Leipzig. A portable loud-speaker outfit furnished music on the streets at a recent public fair

Radio Receivers "Break Jail"

RADIO sets have been banished from the Eastern State Penitentiary following a discovery that convicts were utilizing them to receive dot and dash code messages detailing how narcotics would be smuggled into the prison.

The discovery was made when a visitor was called in by a convict to fix a set in one of the cells. Having a knowledge of code, the visitor, upon adjusting the apparatus, heard a message stating that a rubber ball, filled with drugs, would be tossed over the penitentiary wall on the day the message was received.

He informed the prison officials and shortly afterwards guards placed on watch saw a rubber ball pop over the wall and land on the grass plot inside the prison. When opened it was found to contain a quantity of narcotics. The order banning radio sets was immediately issued.

Radio Used in Oceanographic Survey

GOVERNMENTAL, scientific and military bureaus are now in conference in Washington laying out an extensive program for an oceanographic survey of the world's waters. Interest is centered in an effort to prevent marine disasters, and make for better transportation and communication over the seven seas.

Although neither the route nor the ship and its personnel has been decided upon, one thing is already determined: That the vessel will be equipped with the latest and most efficient radio and sound apparatus designed. The reasons for this are twofold: Primarily it will enable the scientists to keep in constant touch with stations ashore, ascertain their exact locations by radio compass, and bring them standard time signals essential to hydrographic work; and second, it will make exhaustive study of atmospheric disturbances possible, with regard to communication interference. Static will be traced to its lair, if possible, and its source located.

Through the combined efforts of Army, Naval and other governmental bureaus interested in radio, detailed plans for tests in radio reception and transmission will be undertaken wherever the vessel goes on its cruises, which may extend over a period of several years. Into whatever area the ship goes on first assignment for a thorough study of currents, depths, weather, water life and other scientific phases, radio will be utilized both practically for communication and for scientific investigation.

One of the largest frame aerials in England erected on the roof of the Bush Building, London for the use of the U. S. Shipping Board in trans-Atlantic radio communication

It is the hope of Captain Bassett, hydrographer of the navy, to establish a permanent scientific survey system of the world, and that a schedule of trips and areas to be studied may be laid out soon so that appropriations may be secured and the work undertaken within a year.

Radio Lags in Egypt

RADIO has not as yet aroused any great interest in Egypt, although a few enthusiasts are receiving broadcasts from London, Paris and Rome late at night. Private interests have been striving to organize a local broadcast system, with the approval of the government. Permission will not be granted, however, it is said, until regulations are drawn up, and these will not be attempted until after the Paris conference is held this fall.

New Zealand to Develop Broadcasting Line

IF PARLIAMENT passes the scheme formulated by the wireless interests, New Zealand will take her place in national broadcasting.

A company is being formed to control broadcasting throughout New Zealand by establishing four 5,000-watt stations—two in each island (north and south). The company will comprise the wireless trade, listeners-in, and the Government. A deputation of the promoters received a sympathetic hearing from the Government.

Canadian Railroad Acquires CN From Morocco

THE Canadian National Railways have come into possession of the radio call letters of the Moroccan Government, through the courtesy of the French Colonial office and the Moroccan Government.

The call letters are now adopted by the radio stations owned or used by the Canadian National Railways.

The radio call letters of Morocco were CN. To these the Canadian National Railways will add the letter "R" and the first letter of the name of the city from which the broadcasting is being carried on.

The call letters for each city will be Montreal, CNRM; Toronto, CNRT; Winnipeg, CNRW; Regina, CNRR; Saskatoon, CNRS; Calgary, CNRC; Edmonton, CNRE, and the station to be erected in Vancouver will be CNRV.

Radio Fair to Be Held in Berlin

A LARGE radio exhibition is planned in Berlin in connection with the International Automobile Show to be held from September 26 to October 3. At first it was planned to invite foreign radio manufacturers to participate, but it is said that the slump in the domestic radio trade had been so severe that local manufacturers were not willing to assist in giving publicity to any foreign equipment.

Selected Radio Hook-Ups *for the* Home-Builder

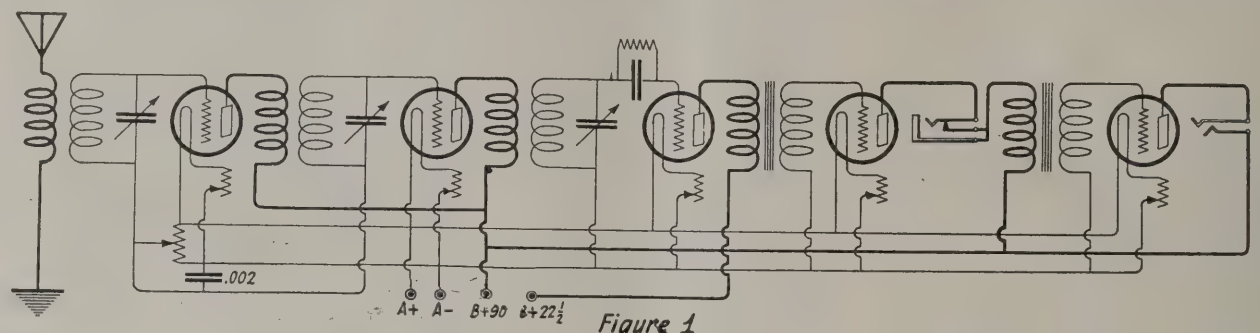


Figure 1

FOR those who are dissatisfied with the available receivers, employing neutralized tuned radio frequency amplification we show the circuit in figure 1. It comprises the same elements as in the tuned neutralized receiver, but incorporates a stabilizing potentiometer across the "A" battery. The filament return leads from the radio frequency transformers are brought to the arm of the potentiometer. The radio-frequency transformers if not already incorporated in your set can be made up on three-inch Bakelite tubing with as thin a wall as possible. The primary and secondary should be wound on the same piece of tubing and the windings separated by three-eighths of an inch. The primary winding consists of twelve turns of No. 24 or No. 22 D. S. C. and the secondary consists of sixty turns of the same size wire. The grid should be connected to the beginning of the secondary and the plate to the end of primary.

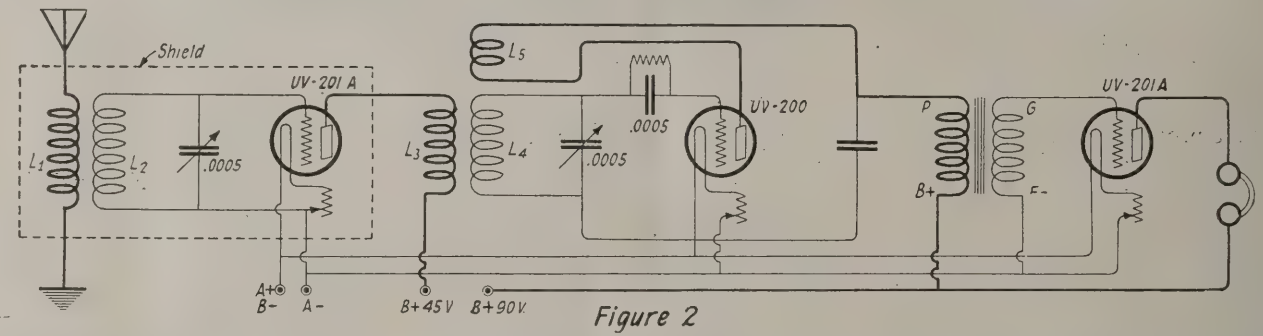


Figure 2

IN the June and May issues of "The Wireless Age," there were given articles on ultra low wave tuners employing an untuned primary circuit, a secondary tuned by a variable condenser and an adjustable tickler coil. Through experiments it was found that it was possible to add a stage of radio-frequency amplification to these tuners. This is shown in figure 2. The part shown behind the shield includes the radio-frequency stage and the remainder of the tuner is just the same as those described previously. L1 consists of four turns of No. 14 D. C. C. wrapped around a 4-inch form and then removing the form. The turns of wire are then wrapped together with a piece of twine and placed up against the secondary coil L2 which consists of 15 turns of the same size wire wrapped on a similar size form. L3 consists of 6 turns of No. 14 D. C. C. wound on a 3-inch form and placed close to L4 which consists of 18 turns. L5 is a coil 3 inches in diameter wound with 18 turns of No. 18 D. C. C., placed so that it can be rotated.

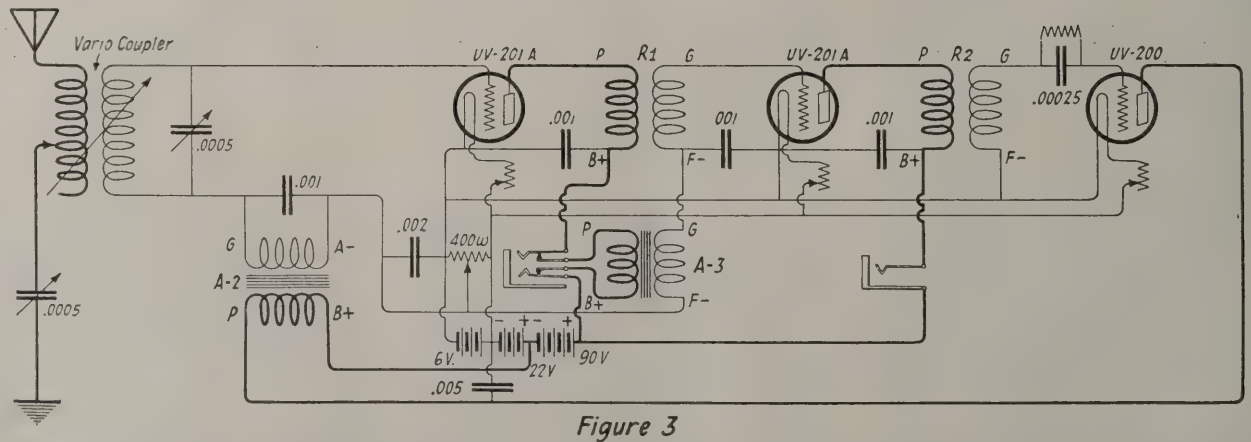


Figure 3

A VERY popular reflex is shown in figure 3. It employs three tubes, two of which are both audio and radio frequency amplifier. R1 and R2 are Acme radio-frequency transformers. A2 and A3 are Acme audio-frequency transformers. An ordinary 180-degree vario-coupler is used to tune the antenna circuit and grid circuit of the first tube.

AFLOAT AND ASHORE WITH THE OPERATOR

ADD to your list of distinguished radio operators the names of Elmer H. Walter and Charles E. Sullivan, Jr. Put them well to the top for few have ever distinguished themselves more and certainly none have displayed greater heroism.

When the *Boston* was rammed by the tank steamer *Swift Arrow* in a dense fog off Point Judith twenty minutes before the midnight hour, Elmer Walter was on watch. Within a few minutes Sullivan was with him.

Elmer H. Walter, heroic chief operator of the Boston

The Captain and officers went below to direct the movements of the passengers into life boats. The three decks above were deserted as was the topmost deck save for the occupants of the radio cabin.

Walter sent out the distress call and the subsequent messages with such clearness and exactness that it brought forth greatly favorable comment from those who heard his signals. He remained cool and collected throughout the ordeal.

When the lights went out, leaving the ship in total darkness except for the lanterns where the boats were being filled far below them, the top deck was no pleasant place to be.

It was necessary for Sullivan to grope his way down to the Captain to convey information and obtain his further orders. His trips necessarily consumed much time and upon his return from each brought discouraging news.

By W. S. Fitzpatrick

The passengers and most of the crew were now off—the remaining lifeboats were ready to push away—the hole in the side was big and the dead could be seen pinned in the wreckage.

Then Sullivan was off to the Captain again leaving Walter in the dismal, dark cabin. The windows and open door showed nothing but black fog.

The ship sank to her guard rail—not slowly but very marked. Walter's six years' sea experience told him that such settling of the ship is the usual forerunner of a sudden dive to the bottom. A lurch of the vessel to the port side seemed to tell him the plunge was about to come—still Elmer Walter stuck and continued to work! And there was Sullivan back to help!

Now came more difficult work. There were a thousand people out in the open sea in small boats who must be saved.

But how? The darkness was intense and their small lights could not penetrate the fog. There was grave danger of being run down by the rescuing steamers.

It was up to Walter and he proved equal to the occasion. With quick wit he assigned each steamer a distinctive signal to be made with the ship's siren. Then with Sullivan out on deck listening for the whistles and Walter directing the movements by radio, the *Priscilla* was able to pick up the passengers, a coast guard cutter to come alongside to take off the dead and the *Commonwealth* with naval vessels to make lines fast and tow the *Boston* into Newport.

To Elmer H. Walter and Charles E. Sullivan the passengers owe their lives and the steamship company the safety of their ship.

* * *

One would imagine that after such harrowing experiences radio men would not care to take further chances. Still they all "ship over" sometimes without even a day in port.

Mr. Walter, who is a prominent member of the Melrose, Mass., lodge of Elks, is running on the ship which took the *Boston's* place, while Mr. Sullivan, who is a college man and whose father is a professor in a large Southern university, is radio man on a small fishing trawler which makes ten-day trips to the fishing banks of the North Atlantic.

* * *

LAST month we printed a letter from Mr. R. J. Dean, of Alameda, Cal., in which he requested that we devote some space to old-time operators who have left the game.

The letter prompted others to make similar requests and feeling that all the old-timers would be glad to learn what has become of their former co-workers of the days of crystal detectors and noisy straight gaps, we would like to hear from those who strayed away.

In addition to letting us know where you are and what you are doing, give us an account of some incidents that happened in your time.

* * *

FRANK ROSENQUIST, operator on the yacht *Hussar,* may be addressed in care of the Independent Wireless Telegraph Company, New York City. Donald J. Pieri has just left the position of commercial engineer, Radio Corporation of America, export division, to take up new duties in Chicago, that of manager of the radio department of the Brunswick-Balke-Collender Company. Richard G.

The Boston's junior operator, Charles E. Sullivan, Jr.

Cuthbert was in the government service during the war, afterward United States Radio Inspector at Norfolk, Va., later in business in the Bronx, and is now operator on the Shipping Board steamer *Haiti.* W. D. Sunderland was last heard of while in the employ of the Alaska Packers Association with L. W. Sturdevant and S. Gaskey.

Distributed Capacity of Radio Receiver Coils

By Ralph R. Batcher
Member Institute of Radio Engineers

MANY have wondered how a coil can act as a condenser since it has no plates, and the ends are short circuited by the wire itself. When a coil is connected in any active alternating current circuit, a relatively high voltage is found across its terminals. Since the inductance of the coil offers a high impedance to radio frequency energy, the very small capacity existing between the ends may represent a considerable current loss.

In general, coils may be readily compared as to which may have the greatest distributed capacity, by examining the following details:

1. Distance between end turns (total length).
2. Length of each turn (circumference).
3. Insulation used on the wire.
4. Size of wire used.
5. Type of tube on which coils are wound.

To keep the distributed capacity low the coils should be long and of small circumference. The insulation should have a low value for its dielectric constant—that is, cotton is better than silk, and silk is better than enamel. Generally speaking the use of small wire will give a lower distributed capacity. Paper, cardboard or a wood tube if perfectly dry has a lower dielectric constant than bakelite or rubber, etc.

Several formulae have been evolved by which the capacity of a coil can be estimated, notably one by P. Drude (data has been published by Dr. A. N. Goldsmith in Vol. 1, of THE WIRLESS AGE, 269), but they are of a form which require empirical factors to take in the effect of the tube on which this coil is wound. Since these factors may vary, due to variations in the composition of the material, the formula will not be repeated here.

The question is often asked, "But what do I gain if I keep the distributed capacity low? I have a condenser across the coil anyway."

In some cases nothing is gained by keeping the distributed capacity low, but in the majority of cases it is a factor worth considering. Two effects are to be considered.

(a) A high distributed capacity lowers the maximum wavelength range. In some cases this may necessitate the introduction of taps on the inductance coil in order to get sufficient wavelength range. Tapped inductances are a source of energy losses and their use is never recommended except as a last resort.

(b) The capacity which is placed across the coil in the shape of a condenser is relatively free from losses, whereas the capacity due to the coil acts the same as if a very leaky condenser is used to tune with. The effect of a good tuning condenser is largely obscured in many cases by the leaky coil capacity across it. The coil capacity may have a dielectric of wire insulation such as enamel, etc., and may be wound on a tube that absorbs considerable energy.

The result is a decrease in selectivity, signal strength and the distance range of a receiver, when coils with large distributed capacity are used.

Probably the single layer coil has the lowest distributed capacity although the spiderweb type of coil is an excellent substitute.

Banked windings have a much higher capacity than a single layer coil having the same inductance. A honeycomb type of coil generally has a lower capacity than a banked wound coil, but still much higher than single layer coils (except possibly in some cases where the coils are wound for very long wavelengths).

The coils should never be varnished, shellacked or coated with any kind of preparation since anything done in this line will increase the capacity.

I have found that the distributed capacity can be measured very readily by the following method in which an oscillator and a calibrated condenser are required. A vacuum tube oscillator is set on some wavelength having a value near the maximum wavelength receivable by the coil under test and the variable condenser. This condenser is then tuned to resonance and the capacity designated C1. The condenser is then adjusted until the first harmonic of the oscillator is received. This harmonic is in nearly all cases readily picked up from any oscillator. The capacity necessary to tune in this harmonic will be somewhat less than one-fourth of the original value used. The value of capacity so determined is designated C2.

$$Cd = \frac{C_1 - 4C_2}{3}$$

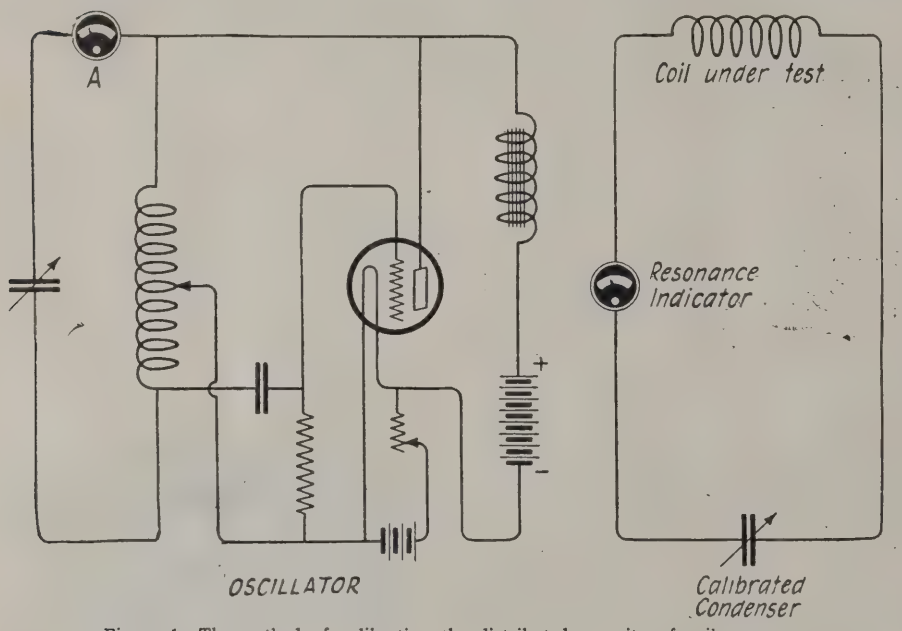


Figure 1—The method of calibrating the distributed capacity of coils

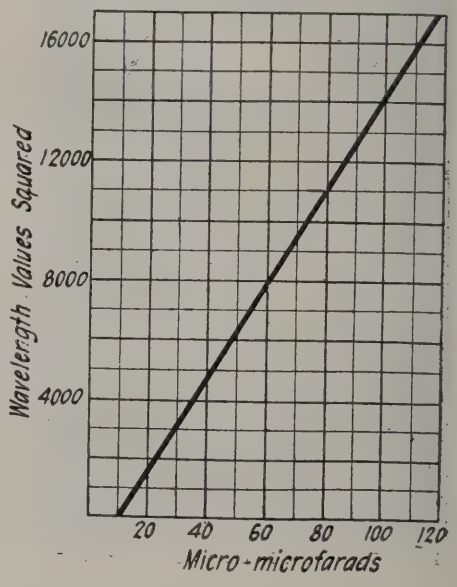


Figure 2—Graph showing distributed capacity of coils

(*Turn to page* 80)

A Different Spiderweb Arrangement

More Satisfactory Operation Is Secured by a Slight Departure from Usual Practice

By Charles Magee Adams

THE cheapness and simplicity of spiderweb coils have for some time made them one of the most popular forms of inductance for use in home-made radio receivers. They can be easily wound. The results compare quite favorably with those obtained from much higher priced and more elaborate equipment, and they can be adapted to a wide range of hookups. However, in one of the best known types of these, the two-circuit, employing primary and secondary coils, many owners have encountered adjustment difficulties so serious that they have often threatened the usefulness of the set.

In sets of this type the primary and secondary are brought into inductive relation with each other, the degree of coupling between the two circuits being determined by the relation of the two coils. But unlike the tickler or feedback the adjustment of this coupling is so critical that it constitutes a considerable handicap rather than an advantage to satisfactory operation. In the case of my own set, built according to this design, a change of adjustment so slight as to be scarcely noticeable weakened signals to such an extent that they were unintelligible and many other set owners have reported the same difficulty. So, to overcome this and at the same time retain the advantages of the two-circuit hookup, I have devised the arrangement shown in Figure 1.

The secondary coil C, it will be noted, is mounted on the stationary supporting bracket according to usual practice. But the primary coil A, instead of being mounted on a rotating bracket to permit a change in the coupling between it and the secondary, is also mounted on the stationary bracket and simply separated from the secondary by the cardboard washer B. The two coils are therefore placed in a fixed parallel inductive relation with each other, giving maximum coupling instead of the usual variable relation, and this can be disturbed only by removing the coils from the bracket.

The thickness of the cardboard washer B will of course have to be determined by experiment. In my own case 5/32 of an inch proved to give the best results—a less amount causing the set to tune too broadly and weakening the signals unduly. But a few minutes trial will show what thickness is best, and once this has been determined the two coils can be mounted together permanently with no fear of reception being interrupted in the middle of a number by the infinitesimal slipping of the primary which is otherwise the bane of the listener's existence.

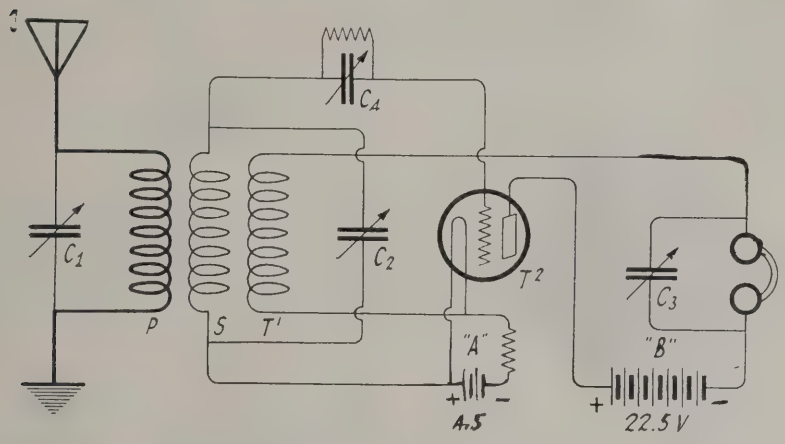


Figure 2—Two-circuit regenerative receiver

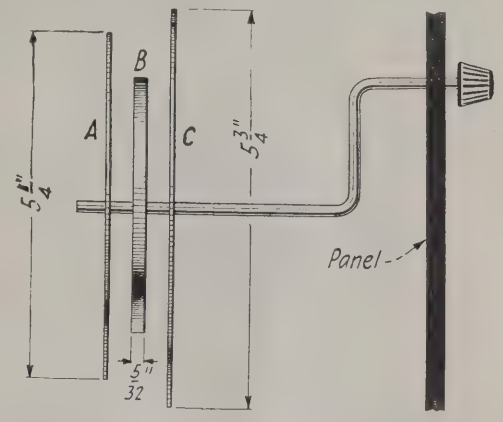


Figure 1—Method of mounting the primary and secondary coils

What's in a Name?

Introducing our proposed new name

The

Radio Magazine

How do you like it? Here's your opportunity to tell us and perhaps win a $10.00 gold piece.

$20.00 in gold For Best Letters

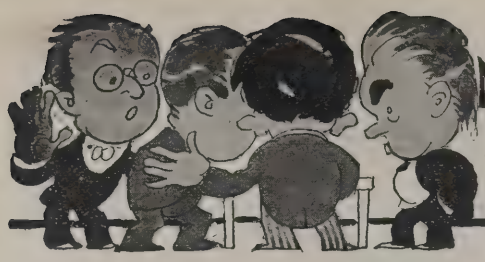
$10.00 in gold for the best letter, not to exceed 200 words, on why you think our new name "THE RADIO MAGAZINE" is a good one for your favorite radio magazine, or—

$10.00 in gold for the best letter, not to exceed 200 words, on why you think we should retain our present name "Wireless Age"

Choose either side. Contest open to all of our readers. Prize winners will be announced in our November issue. The contest ends September 30. Address all letters "Title Contest," Wireless Age, 326 Broadway, New York City.

The hookup used, as can be seen from Figure 2, is of the usual two-circuit regenerative type. The coils are wound respectively, primary 48 turns, secondary 74, and tickler 35, the size of the forms limiting the number of turns in the case of the first two. The tickler too could be reduced to 30 or even 25 turns with somewhat better results, it seems. The tube used is a UV-199.

With a light socket antenna an extreme range 2080 miles has been attained, and as is the usual characteristic of two-circuit sets the tuning has been quite sharp. WLW, ten miles away, operating on 309 meters, can be cut out completely and KDKA, 350 miles away, operating on 326 meters, brought in clearly. WSAI, also on 309 meters, 6 miles away, can be cut out and KPO brought in, 2080 miles away, operating on 423 meters.

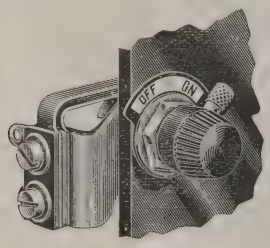


NEW APPLIANCES AND DEVICES

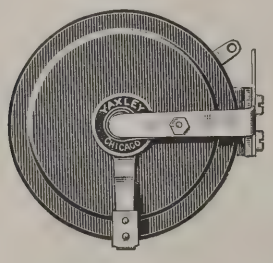
One-Phone Plug

THE YAXLEY MFG. CO., Chicago Ill, has developed a new one-phone plug. Heavy bronze springs grip cord tips full length. Phones are instantly connected without use of tools. Cords cannot be disconnected until handle is removed. All

bakelite insulation prevents current leakage. Undercut tip insulation prevents metal deposit and consequent leakage. Ridged brackets prevent tips becoming short circuited. Fits any jack. The short length handle makes this plug particularly desirable for compact portable sets.



The new midget battery switch made by the Yaxley Mfg. Co., is very compact. It has one nut mounting in a single panel hole. Hard rolled bronze springs. Pure silver contacts. Insulated from metal frame. Quick snap-break contact. Escutcheon plate shows "Off and On" position. A switch of this type is an actual necessity for every tube set.



The new rheostat, made by the same company possesses several unusual and attractive features. The small coil with a large number of turns gives fine tuning without use of vernier attachments. It is smooth in operation and produces no microphonic tube noises. It has a one-nut mounting in a single panel hole. It can be turned in any position to suit wiring layout. All connections are soldered through to terminals. The terminals are tinned for ease of soldering. Made in various resistances to meet all lamp requirements. It is furnished with either knob or graduated dial.

Herald Loud Speaker

THE magnet of this instrument is of tungsten steel, hot forged in special furnaces, to insure the proper magnetic permanency that alone gives uniform qualities through a long life. The core is of special heat treated steel. The coil polepieces are made of a special steel, heat treated.

Expert workmanship, co-ordinate proportions determined upon after lengthy and intensive research, combine to make the Herald model "B" an instrument which will produce volume of response to the most delicate signals.

Overall height is 25 inches and the bell of the fibre horn is 12 inches. The base is an attractive casting of art metal. The Herald model "B" will operate on any receiving set, provided there is at least one stage of amplification. No adjustment is required. No extra batteries required.

N&K Imported Phonograph Unit

THE new N&K Phonograph Unit is similar in construction to the unit used in the N&K imported loud speaker. It is designed especially for use with the Victrola, but is adaptable to any standard phonograph. It attaches securely to the reproducer arm without screws or any special device.

The N&K unit produces the same mellow, distinct tone that characterizes other N&K products, and gives a very satisfactory volume without distortion. It operates efficiently on voltage from 45 to 150.

It comes packed for the trade in an attractive three-color display carton containing a dozen boxes. Each unit is packed in a handsome individual box with imitation black leather-finish imprinted in gold. This package in itself makes a very handsome counter or window display.

Charmitone Loud Singer

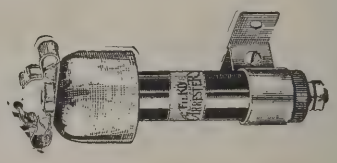
THIS Master-phone enables you to tune in with the super-sensitive stethoscope and to listen in with the horn with perfection on long distance or local programs.

The dial on the Master-phone gives you control over the volume of sound, loud or soft.

The Charmitone patented mechanical features make its operation simple and foolproof. The workmanship and materials, together with a fine finish and its economical operation, makes it a desirable instrument to possess.

New Lightning Arrester

A LIGHTNING arrester is somewhat like a life-preserver in that it is only called upon to work in an emergency. No one knows, as a certainty, whether or not it will function properly until the emergency has passed. So the D. X. Instrument Co., Inc., of Harrisburg, Pa., makers of Fil-Ko-Parts for radio, realized that the usual unconditional guarantee that goes with all Fil-Ko-Parts for radio would not suffice



in the case of a lightning arrester. They have, therefore, issued for the Fil-Ko Lightning Arrester, a special guarantee which provides that should lightning strike an aerial to which a Fil-Ko Lightning Arrester is attached and damage the radio receiver, they will repair the set or pay the purchaser of the arrester $100.00. Thus the arrester protects the set, if it works, and the guarantee protects the owner if it doesn't.

Besides this extraordinary guarantee, the Fil-Ko Lightning Arrester has many other attractive features. The body is made of polished Bakelite, the best, most moistureproof dielectric and is shielded by a

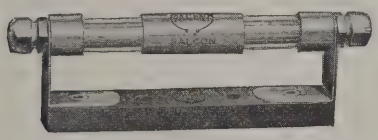
polished aluminum "umbrella" that keeps dust, water and other conductive matter from causing leakage losses in that part of the antenna circuit.

For the first time, a compression type rheostat that can be switched off without being turned off is obtainable. It overcomes the only slight inconvenience that the

compression rheostat has, that of the number of turns required to turn it on or off —and the better the filament control device and the finer the adjustment it allows, the greater the number of turns that are necessary. The Fil-Ko-Stat, allowing as it does, infinite control of current flow, formerly had to be turned off like all other compression rheostats, but can now be left at approximately the correct adjustment, and the "A" battery be disconnected by means of the little, nickel-plated switch that attaches to the regular Fil-Ko-Stat mounting screws on the front of the panel. No extra holes need be drilled. The instrument is guaranteed by the D. X. Instrument Co., Inc.

The Pacent Balcon

THE PACENT ELECTRIC COMPANY, Inc., of New York, manufacturers of the widely used Pacent radio essentials, have recently developed and placed on the market a new balancing condenser. This new condenser, known as the Balcon, is especially designed for use with tuned radio frequency circuits or any other circuit where a capacity balance is desired.



The Balcon consists of two nickel plated electrodes, their ends being 3/16" apart and enclosed in a ¼" glass tube. Around the outside a piece of split brass tubing ¾" long is fitted so that it may be moved from one end of the glass tube to the other. This forms a condenser of very low capacity, the glass tube forming the dielectric. The maximum capacity is obtained when the center of the brass tube coincides with the center of the space between the electrodes. The metal parts are nickel-plated and are mounted on a small radion base.

Electrad "Verni-Tuner"

ELECTRAD Incorporated has recently placed on the market the above unit which has a multiplicity of uses.

It is guaranteed to tune up to 550 meters without an aerial in any sensitive circuit, and the many combinations possible are the following: Combined primary and secondary for radio frequency circuits; for all reflex circuits; for the Electrad Circuit of combined reflex and tuned radio frequency; three-circuit regenerative sets, Ultra-Audion, Erla, and others.

It is completely assembled and is wired up with aerial, ground and output binding posts for panel mounting. The tube sockets are Bakelite, and the condenser has solid Bakelite ends and aluminum plates with micrometer gauged turned brass spacers. All metal parts are nickeled and polished. The primary is untuned. All tuning is accomplished by the 11-plate .00035 variable condenser which is bridged across the secondary.

The manufacturers say that the Verni-tuner also adapts itself to use in a wave-trap curcuit.

Radio and Family Education

(*Continued from page* 36)

eleven miles each way to a school house, pitifully inadequate even when they got to it, I am positively compelled to reach the conclusion that some day radio will carry to all such homes, to parent and child alike, the education which is so very difficult to get in the regions of long distances and sparse settlement.

Not long ago I visited, with much difficulty, a lighthouse on a picturesque spot far out on Long Island. Here, almost entirely cut off in winter time, lives a sturdy Swedish family. There is no such thing as school possible for these children of the lighthouse keeper during half of the school year. But with a bright eye the keeper of that polished beacon light to mariners pointed to his aerial and his crude radio set. It was slung from the top of the lighthouse downward to his house —and he used home-made wooden insulators, too! But what he lacked in high priced equipment, nature made up for him, in his location, for he got good results, and told me of the long winter nights when he and his little brood sat around the stove, with wild storms howling outside, and heard "just everything!" "I can't get my children or my husband to bed any more!" said the sun-tanned mother.

I have already described in another article in the August issue of THE WIRELESS AGE, the radio cooking school which I founded and which is conducted by the big Chicago Gas Company for the women of Chicago. This is the example which I hope will incline others everywhere to provide radio household education. The idea of a study course in cooking, given via radio, took instantly, and has made amazing progress. I predict that soon there will be such radio cooking and housekeeping schools in many large cities. There has already been talk of a Radio University, which I hope will come to pass, for it is certainly practical. The enormous and deserved success of the correspondence schools is an indication of the popular passion for education; also the overcrowded night courses at universities, the summer schools—Columbia has over 10,000 summer students—and the night high schools.

We need to make education still more universal, because it is known that not more than ten persons out of every one hundred ever gets to high school, and even the college presidents are saying that the colleges are too crowded. It seems appalling, but it is true that there are 4,200,000 illiterate people in the United States in spite of our free educational system.

Radio is ideally fitted for the very broad educational work to be done. It is like the Postal Savings system which reaches people the savings banks can't reach, because post offices are everywhere. The radio is everywhere, too, and its work will not interfere with other educational work. There are now over 3,000,000 radio sets in use; a "circulation" greater than that of any of our greatest magazines.

I believe that group radio study classes will be formed in village and farm districts, if the proper material is broadcast, and if it is made possible to secure recognition or credit for radio educational work. Some universities have already made moves in this direction.

There are some surprising educational by-products of radio. Education, after all, is not mere book learning and fact-cramming. Radio is a means of quickening interest and widening perspective—results which have a very high educational value. Our "provincialism" has been demonstrated over and over again, but it is hard to blame our isolated population for it. Distances have been too great to traverse to develop intercourse and social life. The rural telephone is fine for business and social gossip, and the movie is excellent for those who are able to get to the village. But what of the long hours when the isolated people can't leave their homes? That is the very time when radio can help to broaden them.

Education is the obsession of the American man, woman and child, whether a lighthouse keeper or a mountaineer in Kentucky with no roads but the dry creek bed and no library within 200 miles. What, I have thought, would a Lincoln, who traveled many miles to borrow one book, have not done to get such an aid to his education as radio?

Radio can serve a real need—the need of educating the little folk at the family hearth and the extension of the educational work of our universities.

Win a Prize
In the Subscription Contest

Last chance to learn how to earn cash and radio parts as prizes—you earn while you learn

THE contest closes September 15th. The winners will then receive their prizes, and also cash or parts, which they have earned with the subscriptions secured up to that time. But for those who have not entered the contest, I have a good offer that each one can profitably accept *right now.*

Just write a letter to the Boys' Editor. Tell me whether you want a complete set; parts to go with a set you now have; or just what you do want. I will see that you get it.

I have 35,000 names of people who have bought radio sets. Each one of the 35,000 will like to know more about The Wireless Age. Some of those people, in fact, have been taking the magazine, but forgot to renew their subscriptions. Those 35,000 people live in every part of the country. Some of them live in your own town or city.

When I have received your letter telling me what you want in radio, I will write to you and tell you how many subscriptions you must get in order to earn what you want. Even ONE subscription will get you a radio part.

I will teach you how to sell subscriptions. That is important. I will then give you a calling list, supply you with samples and send you out as a full-fledged salesman. You must be a good salesman, and well trained, before we can put the magazine in your hands as a responsible staff-representative in your district.

When I know that you have the right stuff in you, I will give you the appointment for your section and then establish a credit account in your name. You can draw cash from that account or get what you want in radio parts at wholesale prices.

Maurice W. Brink, of Trenton, N. J., who is out to win a prize in our contest

First Prize—Paragon RB2 $135.00 Receiver.
Second Prize—Thompson Magnaphone $35.00 Loud Speaker.
Third Prize—N&K Imported $8.50 Headset.

The contest closes September 15th. All subscriptions for the contest must be in this office not later than that date.

The rules of the contest will be found on this page.

In the event of ties each tying contestant will be awarded a prize identical in character with that tied for.

This contest is open to all who wish to earn their own radio sets.

This is not a temporary affair. The job is open to you as long as you feel that I am giving you the proper attention and a good clean-cut proposition.

Men who make their living by subscription selling have accepted my plan whole-heartedly, and have joined the staff on the basis outlined here.

One special feature deserves attention. To furnish an extra incentive, and to put a little sport into this plan, I have made a contest of the whole affair, and all who want to get in the running must do so at once. Later, I will arrange other contests, but this present one is the big event.

I am giving a Paragon RB2 $135.00 Receiver for first prize. This prize goes to the one who sends in the most subscriptions by September 15th.

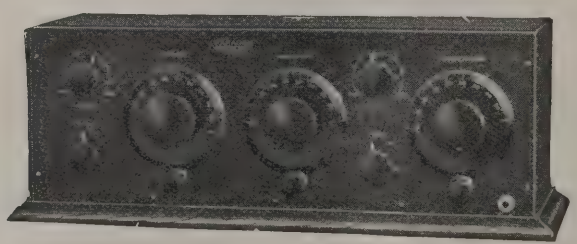
For second prize, I am giving a Thompson Magnaphone $35.00 Loud Speaker to the one who sends in the next largest number of subscriptions by September 15th.

And the third prize is an N&K $8.50 Headset for the one who sends in the third largest number of subscriptions by September 15th.

The prizes will be given in *addition* to what you receive for the subscriptions. If you win a prize, your subscriptions will bring you cash or radio parts just the same. You are paid for your time even though you don't win a prize!

Burt Evans

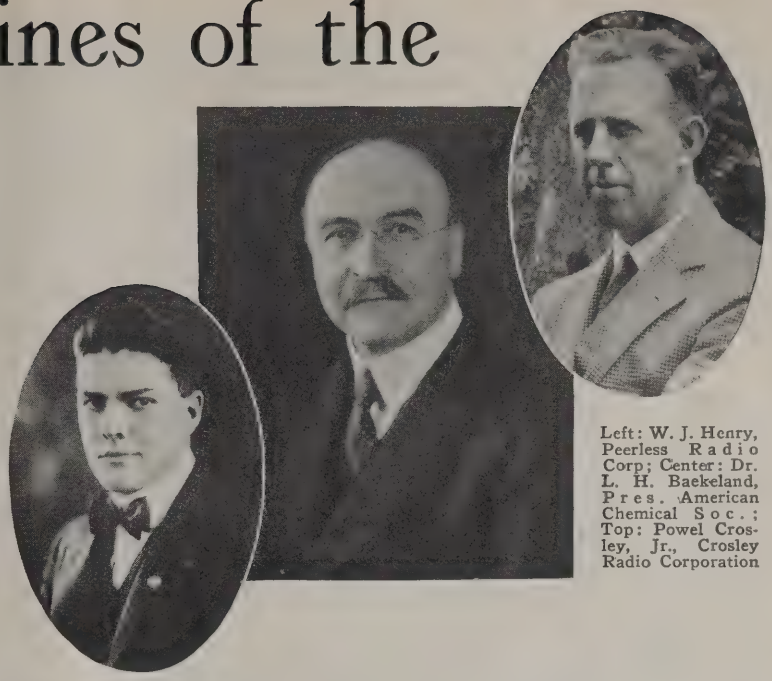
—Boys' Editor.



On the Side Lines of the Industry

THIS MONTH

Mail Order Service—
The Ford Class of Receivers—
Entertaining Advertisers—
Storage Battery Broadcasting—
Fraudulent Practices—
Something New in Hook-Ups—
A New Radio Organization—
Looking Over Some Industrial Booklets.



Left: W. J. Henry, Peerless Radio Corp; Center: Dr. L. H. Baekeland, Pres. American Chemical Soc.; Top: Powel Crosley, Jr., Crosley Radio Corporation

MAITLAND and Spencer Roach, two live young men, have built a successful mail order business in radio on the sound basis of dependability and honest value. Operating in Philadelphia, they have reached out across the country to those who live in out-of-the-way places and thus performed a service. This is worth mention because some mail order houses have exploited the disadvantages of habitants far removed from reliable merchants, and under the guise of service, have too often enjoyed the profitable practice of fleecing the public through misrepresentation. A rather dubious business method, but one that has seemed to flourish.

"WE are building and will continue to build the Ford class of radio equipment—the pocket-book class of merchandise."

With these words, Powel Crosley, Jr. president of The Crosley Radio Corporation brought to a close the second annual convention of Crosley jobbers who had gathered in Cincinnati from every section of the United States.

More than 100 representatives of the nation's leading jobbing houses were in attendance and all departed after the two-day convention, well satisfied with the results of the meeting and determined to prepare for the Crosley Sales Campaign.

A discussion of the Crosley line and a thorough presentation of merchandising problems was the main subject of the meeting. Mr. Crosley particularly stressed the means by which surplus stocks could be moved.

Progressive merchandising, backed with radio expositions and business conventions lays the foundation of a successful radio industry. The result will be reflected in public confidence.

AMONG THE FIVE HUNDRED AND TWENTY-FIVE delegates who sailed on the S. S. *Republic,* July 3rd, bound for the International Convention of the Associated Advertising Clubs of the World at Albert Hall, London, England, were one hundred members of the "Poor Richard Club," Philadelphia, one hundred and twenty-five members of the Advertising Club of New York, one hundred members of the Advertising Club of Chicago—the balance being from San Francisco, Houston, St. Louis, Denver, as well as various representative points in the East.

For the entertainment of these delegates a Brunswick-Radiola was installed on board ship. This Brunswick-Radiola, the first to be utilized in this capacity, is the new product of the Brunswick-Balke-Collender Company and combines both phonograph and radio units in one cabinet.

A special program for the entertainment of those on board the S. S. *Republic* was broadcast each evening from seven-thirty to eight-thirty over Broadcasting Station WOO, operated by John Wanamaker, Philadelphia. By special permission of the officials of the United States Lines, the radio station on board ship was shut down during the period of broadcasting each evening to insure a clear reception of the program.

"THE Storage-Battery Station of the East" is the new designation of Broadcasting Station WDAR, Lit Brothers, Philadelphia, which recently changed its source of transmission power from motor generators to storage batteries.

The new broadcasting power equipment of Station WDAR consists of a 1,760-volt battery made up of 880 cells of a new type of Philco Diamond-Grid Battery designed especially for radio broadcasting and receiving services.

The cells are made up in pressed-glass containers mounted in supporting trays of 20-volt units. The glass containers have high and low water-level lines molded on the sides so that a glance tells whether or not cells are in need of water. One cell in each 10-cell tray unit is provided with a visible built-in charge indicator. The "A" battery used in the Lit Brothers' installation for heating the filaments of the oscillator and modulator tubes consists of 20 large cells of the Philco Diamond-Grid "PMS" type.

THE Pacent Electric Company lays great stress upon the careful inspection and testing of their apparatus before it leaves the factory. In their new factory the testing department has been considerably enlarged and improved in every way. In one corner of the factory there is a model room. In this room may be found practically every kind of radio apparatus ever designed. It is used by Mr. Pacent and his engineers for their experimental work, and in this room are being developed many new Pacent Essentials, that will make their appearance during the coming season.

CHARGED with using fraudulent and misleading advertising, an operator of a chain of retail radio stores in New York City, was haled before the Magistrates' Court.

This man was accused of selling a customer a cut-rate amplifying transformer, represented to be an Acme Transformer, and which was almost an exact duplicate.

In some sections competition in the retail radio business is tremendous and many dealers supply standard brands at prices which are often less than cost. Most standard parts are sold at cut prices and at no profit. In nearly every other business, demand tends to raise prices, but in radio, demand seems to bring the price down, apparently due to the scramble for business. Just how long the condition can exist it is hard to say, but there is no doubt that the public will soon realize that it is cheaper in the end to pay a little more and get the service they surely need.

ELAINE PANDIA RALLI, daughter of Mrs. Constantina Pandia Ralli, of Willowbrook Lane, Stamford, Conn., was married at the Little Church Around the Corner, in New York City, to Thomas Smith Leoser of Morristown, N. J. The bride is a medical student and is finishing her course of training at Bellevue Hospital. The bridegroom is a graduate of Lehigh University, 1916. He spent two years in the service during the war and was Corporal in the 107th Field Artillery. He served one year in France. Mr. Leoser is the chief engineer of the Eagle Radio Company at Newark, N. J. After a two-month honeymoon, Mr. and Mrs. Leoser will make their home in New York City. (*Turn to page* 86)

RADIO LAUGHS

The Wireless Age

—*Life.*

Portable or Not Portable

THE advantages of a portable set have long been harped upon. Now the one great disadvantage of its portability is being discussed by French fans as the result of a recent incident at the radio section of the Paris Fair. Dr. Titus Konteshweller, who has been advertising his portable set, left the set under his desk one day while he walked out for a moment. When he came back the set was gone. French constructors are wondering whether such incidents may not have the effect of discouraging the purchase of sets that are so easily portable.

WEAF Gets a Heart Breaking Appeal

WEAF'S mail frequently contains odd requests but this one from Elgin, Illinois, is particularly so, as its writer has had previous experience.

Station WEAF. Please broadcast:

"I am a widower 38 years of age, height 5 ft. 7 in., weight 160 lbs., light hair, blue eyes; looking for a good wife. I am a cabinet maker by trade. If lonely write H. E. Lawrence, care Station WEAF, 195 Broadway, New York City.

The Psalm of Radio

Radio is my hobby; I shall want no other.
It maketh me to stay home at night.
It leadeth me into much trouble.
It draweth on my purse.
I go into paths of debt for its name's sake.
Yea, though I understand it perfectly, it will not oscillate.
Its concerts and speeches, they comfort me.
Yet it will not work in the presence of mine enemies.
I anoint the coils with shellac;
But the tube spilleth over.
Surely the radio bug won't follow me all the days of my life,
For if it does I will dwell in the house of poverty forever.

—J. D., *World Wide Wireless.*

The Refining Influence of Radio

By H. T. Webster

DEAREST, WON'T YOU PLEASE -
OH, SHUT UP! I'M GOIN' IN AN' WORK TH' RADIO! NOT A-NOTHER WORD OUTA YOU! GET ME?
SMACK!
TONIGHT, KIDDIES, AUNT KUTIE WILL TELL YOU THE STORY OF THE THREE DARLING LITTLE DAISIES THAT LIVED IN THE GREEN, GREEN MEADOW
OUR LITTLE DAISIES HAD FOR NEIGHBORS MR. JACK-IN-THE-PULPIT, MRS. BLUE BELL AND MISS BUTTERCUP, THE DEAREST, CUNNINGEST LITTLE FLOWER IN THE GREEN, GREEN MEADOW
MISS CLOVER, A SWEET LITTLE THING, LIVED SOME DISTANCE FROM THE DAISY SISTERS AND - KIDDIES, WOULD YOU BELIEVE IT? THESE NAUGHTY DAISIES WERE JEALOUS OF HER, OH, SO JEALOUS!
ONE DAY MR. HONEY BEE CAME HURRYING INTO THE GREEN, GREEN MEADOW AS FAST AS HIS LITTLE WINGS WOULD CARRY HIM. THE DAISY SISTERS WERE OH SO EXCITED. THEY WERE SURE MR. BEE HAD COME TO SEE THEM.
'BUZZ! BUZZ' BUZZ!" SAID MR BEE TO THE DAISIES "WHERE DOES MISS CLOVER LIVE?"
GUS! WH-WH-WHAT HAS HA-MY G-!
MY DEAR! I'VE JUST HEARD THE DARLINGEST STORY OVER THE RADIO! IT WAS ABOUT THREE PRECIOUS LITTLE DAISIES AND A PERFECT LOVE OF A HONEY BEE. MERCY! I GOT SO VERY, VERY EXCITED I ALMOST SCREAMED!

N. Y. World.

BROADCASTING STATION DIRECTORY

The Most Authentic, Up-to-the-Minute List of Stations Broadcasting in the United States, Canada, England, France and Cuba

United States Stations

KDKA Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. 326
KDPM Westinghouse Elec. & Mfg. Co., Cleveland, O. 270
KDPT Southern Electric Co.....San Diego, Calif. 244
KDYL Newhouse Hotel.....Salt Lake City, Utah 360
KDYM Savoy Theater.....San Diego, Calif. 280
KDYQ Oregon Institute of Technology, Portland, Ore. 360
KDZB Frank E. Siefert.....Bakersfield, Calif. 240
KDZE Rhodes Department Store.....Seattle, Wash. 270
KDZI Electric Supply Co.....Wenatchee, Wash. 360
KDZR Bellingham Publishing Co., Bellingham, Wash. 261
KFAD McArthur Bros. Mercantile Co....Phoenix, Ariz. 360
KFAE State College of Washington....Pullman, Wash. 330
KFAF Western Radio Corp.....Denver, Colo. 360
KFAJ University of Colorado.....Boulder, Colo. 360
KFAR Studio Lighting Service Co....Hollywood, Calif. 280
KFAW The Radio Den.....Santa Ana, Calif. 280
KFAY Virgin's Radio Service.....Medford, Ore. 283
KFBB F. A. Buttrey & Co.....Havre, Mont. 360
KFBC W. K. Azvill.....San Diego, Calif. 278
KFBE Reuben H. Horn.....San Luis Obispo, Calif. 242
KFBG First Presbyterian Church.....Tacoma, Wash. 360
KFBK Kimball-Upson Co.....Sacramento, Calif. 283
KFBL Leese Bros. .....Everett, Wash. 224
KFBS Trinidad Gas & Electric Supply Co. and the Chronicle News, Trinidad, Colo. 360
KFBU The Cathedral .....Laramie, Wyo. 283
KFCB Nielsen Radio Supply Co.....Phoenix, Ariz. 238
KFCF Frank A. Moore.....Walla Walla, Wash. 360
KFCV Fred Mahaffey, Jr.....Houston, Tex. 360
KFCZ Omaha Central High School.....Ohama, Nebr. 258
KFCP Ralph W. Flygare.....Ogden, Utah 360
KFDD St. Michael's Cathedral.....Boise, Idaho 252
KFDH University of Arizona.....Tucson, Ariz. 268
KFDJ Oregon Agricultural College.....Corvallis, Ore. 360
KFDX First Baptist Church.....Shreveport, La. 360
KFDY South Dakota State College..Brookings, S. Dak. 360
KFDZ Harry Q. Iverson.....Minneapolis, Minn. 231
KFEC Meier & Frank Co.....Portland, Ore. 248
KFEK Augsburg Seminary .....Minneapolis, Minn. 261
KFEL Winner Radio Corporation.....Denver, Colo. 254
KFEQ J. L. Scroggin.....Oak, Nebr. 268
KFER Auto Electric Service Co.....Fort Dodge, Iowa 231
KFEV Felix Thompson Radio Shop.....Casper, Wyo. 263
KFEY Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho 360
KFEZ Associated Engineering Societies of St. Louis, St. Louis, Mo. 248
KFFB Jenkins Furniture Co.....Boise, Idaho 240
KFFE Eastern Oregon Radio Co.....Pendleton, Ore. 360
KFFR Nevada State Journal.....Sparks, Nev. 226
KFFV Graceland College .....Lamoni, Iowa 280
KFFX McGraw Co. .....Omaha, Nebr. 278
KFFY Pincus & Murphy.....Alexandria, La. 275
KFGC Louisiana State University....Baton Rouge, La. 254
KFGD Chickasha Radio & Elec. Co., Chickasha, Okla. 248
KFGL Snell & Irby.....Arlington, Ore. 234
KFGQ Crary Hardware Co.....Boone, Iowa 226
KFGB Heidbreder Radio Supply Co.....Utica, Nebr. 224
KFGX First Presbyterian Church.....Orange, Tex. 250
KFGZ Emmanuel Missionary Coll..Berrien Spgs., Mich. 285
KFHA Western State College of Colo., Gunnison, Colo. 252
KFHH Ambrose A. McCue.....Neah Bay, Wash. 261
KFHJ Fallon & Co.....Santa Barbara, Calif. 360
KFHR Star Electric & Radio Co.....Seattle, Wash. 283
KFI Earle C. Anthony (Inc.)....Los Angeles, Calif. 469
KFID Ross Arbuckle's Garage.....Iola, Kans. 246
KFIF Benson Polytechnic Institute.....Portland, Ore. 360
KFIL Windisch Elec. Farm Equip. Co., Louisburg, Kans. 234
KFIO North Central High School.....Spokane, Wash. 252
KFIQ Yakima Valley Radio Broadcasting Association, Yakima, Wash. 242
KFIU Alaska Elec. Light & Power Co., Juneau, Alaska 226
KFIX Reorganized Church of Jesus Christ of Latter Day Saints, Independence, Mo. 240
KFIZ Daily Commonwealth and Oscar A. Huelsman, Fond-du-Lac, Wis. 273
KFJB Marshall Electric Co.....Mashalltown, Iowa 248
KFJC Seattle Post-Intelligencer.....Seattle, Wash. 270
KFJF National Radio Mfg. Co., Oklahoma City, Okla. 252
KFJI Liberty Theater .....Astoria, Ore. 252
KFJK Delano Radio & Electric Co.....Bristow, Okla. 233
KFJL Hardsaeg Manufacturing Co.....Ottumwa, Iowa 242
KFJM University of North Dakota, Grand Forks, N. D. 280
KFJQ Electric Construction Co., Grand Forks, N. Dak. 280
KFJR Ashley C. Dixon & Son....Stevensville, Mont. 258
KFJX Iowa State Teachers College, Cedar Falls, Iowa 280
KFJY Tunwall Radio Co.....Fort Dodge, Iowa 246
KFJZ Texas Nat'l Guard, 112 Cav., Fort Worth, Tex. 254
KFKA Colorado State Teachers' Coll....Greeley, Colo. 273
KFKB Brinkley-Jones Hospital Assn., Milford, Kans. 286
KFKQ Conway Radio Laboratories.....Conway, Ark. 250
KFKV F. F. Gray.....Butte, Mont. 283
KFKX Westinghouse Elec. & Mfg. Co., Hastings, Nebr. 341
KFKZ Nassour Bros. Radio Co., Colorado Springs Colo. 234
KFLA Abner R. Wilson.....Butte, Mont. 283
KFLB Signal Electric Mfg. Co.....Menominee, Mich. 248
KFLD Paul E. Greenlaw.....Franklinton, La. 234
KFLE National Education Service.....Denver, Colo. 268
KFLQ Bizzell Radio Shop.....Little Rock, Ark. 261
KFLU Rio Grande Radio Supply House, San Benito, Tex. 236
KFLV A. T. Frykman.....Rockford, Ill. 229
KFLX George R. Clough.....Galveston, Tex. 240
KFLY Fargo Radio Supply Co.....Fargo, N. Dak. 231
KFLZ Atlantic Automobile Co.....Atlantic, Iowa 273
KFMB Christian Churches of Little Rock, Little Rock, Ark. 254
KFMQ University of Arkansas.....Fayettsville, Ark. 263
KFMR Morningside College .....Sioux City, Iowa 261
KFMT George W. Young.....Minneapolis, Minn. 231
KFMW M. G. Satern.....Houghton, Mich. 266
KFMX Carleton College .....Northfield, Minn. 283
KFNF Henry Field Seed Co.....Shenandoah, Iowa 266
KFNG Wooten's Radio Shop.....Coldwater, Miss. 254
KFNJ Warrensburg Electric Shop....Warrensburg, Mo. 234
KFNL Radio Broadcast Association..Paso Robles, Calif. 240
KFNV L. A. Drake.....Santa Rosa, Calif. 234
KFNX Peabody Radio Service.....Peabody, Kans. 240
KFNY Montana Phonograph Co.....Helena, Mont. 261
KFNZ Royal Radio Co.....Burlingam, Calif. 231
KFOA Rhodes Co. .....Seattle, Wash. 455
KFOC First Christian Church.....Whittier, Calif. 236
KFOD The Radio Shop.....Wallace, Idaho 224
KFOJ Moberly High School Radio Club, Moberly, Mo. 246
KFOL Leslie M. Schafbuch.....Marengo, Iowa 234
KFON Echophone Radio Shop.....Long Beach, Calif. 234
KFPB Edwin J. Brown.....Seattle, Wash. 224
KFPT Cape & Johnson.....Salt Lake City, Utah 268
KFQE Dickenson-Henry Radio Laboratories, Co.orado Springs, Colo.
KFQF Donald A. Boult.....Minneapolis, Minn.
KFSG Echo Park Evangelistic Assn., Los Angeles, Calif. 278
KGB Tacoma Daily Ledger.....Tacoma, Wash, 252
KGG Hallock Watson Radio Service....Portland, Ore. 360
KGO General Electric Co.....Oakland, Calif. 312
KGU Marion A. Mulrony.....Honolulu, Hawaii 360
KGW Portland Morning Oregonian.....Portland, Ore. 492
KGY St. Martins College.....Lacey, Wash. 258
KHJ Times-Mirror Co. .....Los Angeles, Calif. 395
KHQ Louis Wasmer .....Seattle, Wash. 360
KJQ C. O. Gould.....Stockton, Calif. 273
KJR Northwest Radio Service Co.....Seattle, Wash. 283
KJS Bible Inst. of Los Angeles, Los Angeles, Calif. 360
KLS Warner Bros. Radio Supplies Co., Oakland, Calif. 360
KLX Tribune Publishing Co.....Oakland, Calif. 509
KLZ Reynolds Radio Co.....Denver, Colo. 283
KMJ San Joaquin Light & Power Corp., Fresno, Calif. 248
KMO Love Electric Co.....Tacoma, Wash. 360
KNT Walter Hemrich .....Kukak Bay, Alaska 263
KNX Electric Lighting Supply Co., Los Angeles, Calif. 360
KOB New Mexico College of Agriculture & Mechanic Arts, State College, N. Mex. 360
KOP Detroit Police Department.....Detroit, Mich. 286
KPO Hale Bros. .....San Francisco, Calif. 423
KQP Apple City Radio Club.....Hood River, Ore. 360
KQV Doubleday-Hill Electric Co.....Pittsburgh, Pa. 270
KQW Charles D. Herrold.....San Jose, Calif. 360
KRE Berkeley Daily Gazette.....Berkeley, Calif. 275
KSD Post-Dispatch .....St. Louis, Mo. 546
KTW First Presbyterian Church.....Seattle, Wash. 360
KUO Examiner Printing Co....San Francisco, Calif. 360
KUY Coast Radio Co.....El Monte, Calif. 256
KWG Portable Wireless Telephone Co., Stockton, Calif. 360
KWH Los Angeles Examiner.....Los Angeles, Calif. 360
KYQ The Electric Shop.....Honolulu, Hawaii 270
KYW Westinghouse Electric & Mfg. Co., Chicago, Ill. 536
KZM Preston D. Allen.....Oakland, Calif. 360
WAAB Valdemar Jensen .....New Orleans, La. 268
WAAC Tulane University.....New Orleans, La. 360
WAAD Ohio Mechanics Institute.....Cincinnati, Ohio 360
WAAF Chicago Daily Drovers Journal....Chicago, Ill. 286
WAAM I. R. Nelson Co.....Newark, N. J. 263
WAAN University of Missouri.....Columbia, Mo. 254
WAAW Omaha Grain Exchange.....Omaha, Nebr. 286
WABB Harrisburg Sporting Goods Co...Harrisburg, Pa. 266
WABD Parker High School.....Dayton, Ohio 283
WABE Y. M. C. A.....Washington, D. C. 283
WABG Arnold Edwards Piano Co.....Jacksonville, Fla. 275
WABH Lake Shore Tire Co.....Sandusky, Ohio 240
WABI Bangor Railway & Electric Co....Bangor, Me. 240
WABL Connecticut Agricultural College...Storrs, Conn. 283
WABM F. A. Doherty Automotive & Radio Equipment Co., Saginaw, Mich. 254
WABO Lake Avenue Baptist Church, Rochester, N. Y. 283
WABP Robert F. Weinig.....Dover, Ohio 266
WABQ Haverford College Radio Club...Haverford, Pa. 261
WABR Scott High School.....Toledo, Ohio 270
WABT Holliday-Hall .....Washington, Pa. 252
WABU Victor Talking Machine Co.....Camden, N. J. 226
WABV John H. DeWitt.....Nashville, Tenn. 263
WABW College of Wooster.....Wooster, Ohio 234
WABX Henry B. Joy.....Mount Clemens, Mich. 270
WABY John Magaldi, Jr.....Philadelphia, Pa. 242
WABZ Coliseum Place Baptist Church..New Orleans, La. 263
WBAA Purdue University.....West Lafayette, Ind. 360
WBAH The Dayton Co.....Minneapolis, Minn. 417
WBAN Wireless Phone Corporation.....Paterson, N. J. 244
WBAO James Millikin University.....Decatur, Ill. 360
WBAP Wortham-Carter Pub. Co. (Star Telegram), Fort Worth, Tex. 476
WBAV Erner & Hopkins Co.....Columbus, Ohio 423
WBAX John H. Stenger, Jr.....Wilkes-Barre, Pa. 360
WBAY Western Electric Co.....New York, N. Y. 492
WBBA Newark Radio Laboratories.....Newark, Ohio 240
WBBD Barbey Battery Service.....Reading, Pa. 234
WBBG Irving Vermilya .....Mattapoisett, Mass. 248
WBBH J. Irving Bell.....Port Huron, Mich. 246
WBBJ Neel Electric Co.....West Palm Beach, Fla. 258
WBBL Grace Covenant Church .....Richmond, Va. 283
WBBM Frank Atlass Produce Co.....Lincoln, Ill. 226
WBBN A. B. Blake .....Wilmington, N. C. 275
WBBP Petoskey High School .....Petoskey, Mich. 246
WBBR Peoples Pulpit Association.....Rossville, N. Y. 273
WBBT Lloyd Bros. .....Philadelphia, Pa. 234
WBBU Jenks Motor Sales Co. .....Monmouth, Ill. 224
WBBV Johnstown Radio Co. .....Johnstown, Pa. 248
WBBW Ruffner Junior High School.....Norfolk, Va. 222
WBBY Washington Light Infantry....Charleston, S. C. 268
WBBZ Noble S. Watson.....Indianapolis, Ind. 227
WBS D. W. May (Inc.) .....Newark, N. J. 360
WBT Southern Radio Corporation....Charlotte, N. C. 360
WBZ Westinghouse Elec. & Mfg. Co., Springfield, Mass. 337
WCAD St. Lawrence University.....Canton, N. Y. 280
WCAE Kaufmann & Bauer Co.....Pittsburgh, Pa. 462
WCAG Clyde R. Randall .....New Orleans, La. 268
WCAH Entrekin Electric Co. .....Columbus, Ohio 286
WCAJ Nebraska Wesleyan University, University Place, Nebr. 360
WCAK Alfred P. Daniel .....Houston, Tex. 263
WCAL St. Olaf College .....Northfield, Minn. 360
WCAO Sanders & Stayman Co.....Baltimore, Md. 360
WCAP Chesapeake & Potomac Tel. Co., Washington, D. C. 469
WCAR Southern Radio Corp. of Texas, San Antonio, Tex. 360
WCAS William Hood Dunwoody Industrial Institute Minneapolis, Minn. 280
WCAT South Dakota State School of Mines, Rapid City, S. Dak. 240
WCAU Durham & Co. .....Philadelphia, Pa. 286
WCAV J. C. Dice Electric Co.....Little Rock, Ark. 360
WCAX University of Vermont .....Burlington, Vt. 360
WCAZ Carthage College .....Carthage, Ill. 246
WCBA Charles W. Helmbach .....Allentown, Pa. 280
WCBC University of Michigan.....Ann Arbor, Mich. 280
WCBD Wilbur G. Voliva .....Zion, Ill. 345
WCBE Uhalt Radio Co. .....New Orleans, La. 263
WCBG Howard S. Williams .....Pascagoula, Miss. 268
WCBH University of Mississippi .....Oxford, Miss. 242
WCBM Charles Schwarz .....Baltimore, Md. 360
WCBX Radio Shop of Newark.....Newark, N. J. 233
WCBZ Coppotelli Brothers' Music House, Chicago Heights, Ill.
WCK Stix-Baer & Fuller Dry Goods Co., St. Louis, Mo. 360
WCX Detroit Free Press .....Detroit, Mich. 517
WDAE Tampa Daily Times .....Tampa, Fla. 360
WDAF Kansas City Star .....Kansas City, Mo. 411
WDAG J. Laurance Martin .....Amarillo, Tex. 263
WDAH Trinity Methodist Church (South), El Paso, Tex. 268
WDAK The Courant .....Hartford, Conn. 261

WDAP	Drake Hotel	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum & Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corporation	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBL	Immanuel Lutheran Church of Valparaiso,	Valparaiso, Ind.	
WDBP	Superior State Normal School,	Superior, Wis.	
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill.	278
WEAA	Frank D. Fallain	Flint, Mich.	250
WEAF	American Tel. & Tel. Co.	New York, N.Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	280
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermilion, S. Dak.	283
WEAM	Borough of North Plainfield,	North Plainfield, N. J.	286
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Evening News Publishing Co.	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theater	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEBH	Edgewater Beach Hotel Co.	Chicago, Ill.	360
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	263
WEW	St. Louis University	St. Louis, Mo.	280
WFAA	Dallas News and Dallas Journal	Dallas, Tex.	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAH	Electric Supply Co.	Port Arthur, Tex.	236
WFAN	Hutchinson Elec. Service Co.,	Hutchinson, Minn.	360
WFAV	University of Nebraska	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Elec. Sup. & Const. Co.,	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	W. G. Patterson	Shreveport, La.	252
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio and Research Corporation,	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	Chicago Radio Laboratory	Chicago, Ill.	448
WGR	Federal Tel. & Tel. Co.	Buffalo, N. Y.	319
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of	Music), Rochester, N. Y.	283
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal and Louisville Times,	Louisville, Ky.	400
WHAV	Wilmington Elec. Spec. Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co.	Cleveland, Ohio	283
WHN	George Schubel	New York, N. Y.	360
WIAB	Art A. Johnson's Garage	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Tex.	360
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee,	Milwaukee, Wisc.	246
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIK	K. & L. Electric Co.	McKeesport, Pa.	234
WIL	Continental Elec'l Supply Co.,	Washington, D. C.	360
WIP	Gimbel Bros.	Philadelphia, Pa.	509
WJAD	Jackson's Radio Eng'g Laboratories	Waco, Tex.	360
WJAG	Norfolk Dairy News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co.	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	286
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJD	Denison University	Granville, Ohio	229
WJY	Radio Corporation of America,	New York, N. Y.	405
WJZ	Radio Corporation of America,	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	278
WKAD	Charles Looff (Crescent Park),	E. Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex.	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corporation of Porto Rico,	San Juan, P. R.	360
WKAR	Michigan Agri. College,	East Lansing, Mich.	280
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corporation,	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Schilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of N. Y.	New York, N. Y.	360
WLAX	Putnam Electric Co.	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLBL	Wisconsin Dept. of Markets.	Stevens Point, Wis.	
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	423
WMAC	Clive B. Meredith	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presby. Church,	St. Louis, Mo.	280
WMC	Commercial Appeal	Memphis, Tenn.	500
WMU	Doubleday-Hill Electric Co.,	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	266
WNAP	Wittenberg College	Springfield, Ohio	275
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	360
WNAW	Henry Kunzman	Box 167, Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.,	Yankton, S. Dak.	244
WNYC	Municipality of New York	New York City	526
WOAC	Page Organ Co. (H. P. Maus)	Lima, Ohio	266
WOAE	Midland College	Fremont, Nebr.	280
WOAF	Tyler Commercial College	Tyler, Tex.	360
WOAG	Apollo Theater	Belvidere, Ill.	273
WOAH	Palmetto Radio Corporation	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Tex.	385
WOAN	James D. Vaughn	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 112th Inf.	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic.	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Market'g Bu.,	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Co.	Okmulgee, Okla.	330
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College,	Agricultural College, N. D.	283
WPAL	Avery & Loeb Electric Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAU	Concordia College	Moorehead, Minn.	286
WPAZ	John R. Koch	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkesburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Tele. & Teleg. Co.,	Mattoon, Ill.	258
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	W. Texas Radio Co. (Abilene Dairy Reporter),	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Co.	Peoria, Ill.	248
WQJ	Calumet Rainbow Broadcasting Co.,	Chicago, Ill.	
WRAF	The Radio Club	Laporte, Ind.	224
WRAL	Northern States Power Co.,	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	St. Louis Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop	Reading, Pa.	238
WRAX	Flexon's Garage	Gloucester City, N. J.	268
WRC	Radio Corporation of America,	Washington, D. C.	469
WRK	Doron Bros. Electrical Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas, Police and Fire Signal Dept.,	Dallas, Texas	360
WRW	Tarrytown Radio Res'ch Lab.,	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College,	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural Col.,	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAI	United States Playing Card Co.,	Cincinnati, O.	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Temple	N. Y. City	263
WSAR	Doughty & Welch Elec. Co.,	Fall River, Mass.	254
WSAY	Port Chester Chamber of Commerce,	Port Chester, N. Y.	233
WSAZ	Chase Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electrical Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAC	Penn Traffic Co.	Johnstown, Pa.	275
WTAF	Louis J. Gallo	New Orleans, La.	268
WTAG	Kern Music Co.	Providence, R. I.	258
WTAJ	The Radio Shop	Portland, Me.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.,	Boston, Mass.	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural and Mechanical College of Texas,	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station,	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College,	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co.	Trenton, N. J.	226
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Lawrence J. Crowley	Joliet, Ill.	227
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	280

Canadian Stations

CKLC	Wilkinson Electric Co., Ltd.	Calgary, Alta.	400
CJCD	T. Eaton Co., Ltd.	Toronto, Ont.	410
CFCU	Jack V. Elliot, Ltd.	Hamilton, Ont.	410
CFLC	Chas. Guy Hunter	London, Ont.	430
CHCS	The Hamilton Spectator	Hamilton, Ont.	410
CHYC	Northern Electric Co., Ltd.	Montreal, P. Q.	341
CFCF	Marconi W. T. Co. of Can., Ltd.,	Montreal, P. Q.	440
CKCO	Dr. G. M. Geldert	Ottawa, Ont.	400
CHNC	Toronto Radio Research Society,	Toronto, Ont.	350
CKCH	Canadian National Railways	Ottawa Ont.	435
CJCM	J. L. Philippe Landry	Mont Joli, P. Q.	312
CHXC	J. R. Booth, Jr.	Ottawa, Ont.	435
CHCE	Western Canada Radio Supply,	Victoria, B. C.	400
CKY	Manitoba Telephone System	Winnipeg, Man.	450
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CFCA	Star Publishing & Printing Co.,	Toronto, Ont.	400
CFAC	The Calgary Herald	Calgary, Alta.	430
CKAC	La Presse Publishing Co., Ltd.,	Montreal, P. Q.	430
CFCH	Abitibi Power & Paper Co., Ltd.,	Iroquois Falls, Ont.	400
CJCF	The News Record	Kitchener, Ont.	295
CJGC	London Free Press Printing Co., Ltd.,	London, Ont.	430
CFRC	Queen's University	Kingston, Ont.	450
CFCQ	Radio Specialties, Ltd.	Vancouver, B. C.	450
CFDC	Sparks Company	Nanaimo, B. C.	430
CJCA	The Edmonton Journal, Ltd.	Edmonton, Alta.	450
CFCK	Radio Supply Co., Ltd.	Edmonton, Alta.	410
CJCE	Sprott Shaw Radio Co.	Vancouver, B. C.	400
CFCL	Centennial Methodist Church	Victoria, B. C.	400
CJSC	The Evening Telegram	Toronto, Ont.	430
CFYC	Victor Wentworth Odium	Vancouver, B. C.	400
CFXC	Westminster Trust Co.	New Westminster, B. C.	440
CKCI	Le "Soliel" Limitee	Quebec, P. Q.	295
CFQC	The Electric Shop, Ltd.	Saskatoon, Sask.	400
CHBC	The Albertan Publishing Co.	Calgary, Alta.	410

British Stations

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740
FL	Paris (Eiffel Tower)	2,600
ESP	Paris	450
8AJ	Paris	1,780

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Vélez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramirez	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JQ	Raul Pérez Falcon	Habana	150
2KP	Alvaro Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopold V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
5EV	Leopoldo V. Figueroa	Colon	360
6DW	Eduardo Terry	Cienfuegos	225
6BY	José Ganduxe	Cienfuegos	300
6AZ	Valentin Ulivarri	Cienfuegos	200
6EV	Josefa Alvarez	Caibarién	225
7AZ	Pedro Nogueras	Camaguey	225
7BY	Salvador Dionda	Camaguey	350
8AZ	Alfredo Broocks	Santiago de Cuba	240
8BY	Alberto Ravelo	Santiago de Cuba	250
8FU	Andrés Vinnet	Santiago de Cuba	225
8DW	Pedro C. Anduz	Santiago de Cuba	275
8EV	Eduardo Mateos	Santiago de Cuba	180
8GT	Juan F. Chibas	Santiago de Cuba	260

CONDUCTED BY R. A. BRADLEY

Due to the great volume of correspondence which this department entails, we are forced to remind our readers on the following points. Be sure to inclose a self-addressed stamped envelope with your questions. Make your questions clear and concise. If you wish information on your set, please inclose a rough sketch of hook-up if possible. Do not ask us to tell you how far your set will receive or how far any set should receive. It is impossible to answer this question as there are too many things which enter into distance reception and too many variable elements to make a qualified statement. Please do not ask us to make comparisons between different makes of apparatus or sets. We printed in the Information Desk for May what we termed an ideal letter. If you wish immediate response to your inquiries, follow the general outline of this letter.

IN the August issue of THE WIRELESS AGE the list of materials for the construction of the Super-tone Amplifier was omitted. As it is very important to use the proper materials in constructing this amplifier we are printing here the list as it should have appeared.

List of Materials for the Super-Tone Amplifier

One 7" x 18" bakelite panel.
One 12½" x 2" binding post strip, bakelite.
Two Pacent double circuit filament lighting jacks.
One Pacent single circuit filament lighting jack.
One pair Como push-pull amplifying transformers.
Nine Eby binding posts.
Five NaAld de luxe sockets.
Three Fil-Ko-Stats.
Two Daven Resisto Couplers complete.
One Daven grid leak and grid condenser mounting.
One 12" x 18" baseboard.
Two Quinby large size aluminum frames.
Fourteen lengths of Essex Skwareflex Bus Bar.

Mr. P. Tilman, Cleveland, Ohio, writes concerning the "D" coil receiver. "The diagram for the 'D' coil receiver did not show where the negative of the 'B' battery was to be connected. I would like to know also if I could use the No. 65 audio-frequency transformers made by the Federal Tel. & Tel. Co. in place of those mentioned."

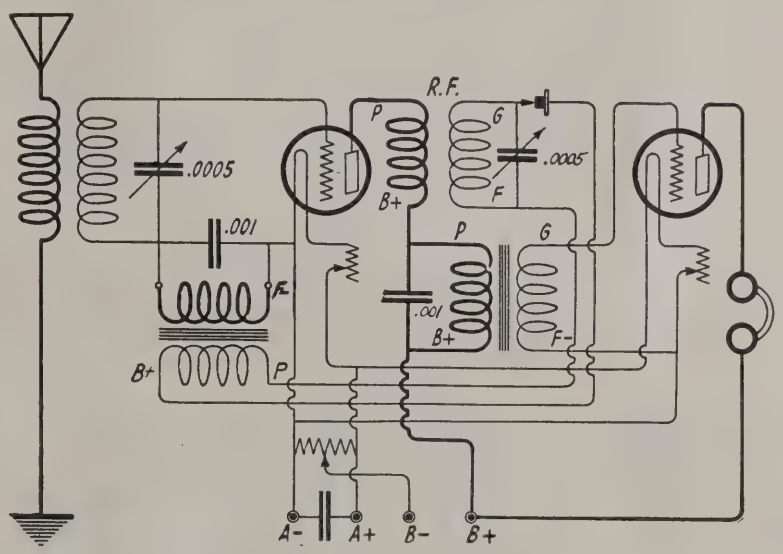
The positive of the "A" battery is also the binding post for the negative of the "B" battery as in most amplifying circuits. It is perfectly possible to use an additional binding post for the negative "B" battery but it simplifies matters to use the "A" for both. The transformers which you mentioned can be used very successfully on this receiver.

M. E. H. Cunningham, Boston, Mass., asks: "What steps may be taken to prevent interference from a small house lighting plant located near the receiver?"

You will have considerable trouble in eliminating the disturbances set up by the lighting installation if the receiver is situated near the engine. Interference due to sparking at the commutator of the dynamo can often be eliminated by the use of a counterpoise instead of by the usual ground connection. You may also find it to advantage to connect a large condenser, one or two mfd. across the brushes of the machine. Radiation from the ignition system of an engine can often be suppressed by encasing the high voltage wiring in metal braid. This metal braid should then be connected to the frame of the engine or grounded in some other fashion.

Mr. Harry W. Trott, of Cleveland, Ohio, writes: "I have a Harkness Reflex, one tube with crystal which is doing very good work. Will you please give me a diagram for the addition of one stage of amplification, audio frequency?"

The diagram for this is shown here. The only apparatus necessary to make the change includes one transformer, one tube socket, rheostat and an additional tube. Be sure not to leave out the .001 mfd. condenser across the primary of the added audio-frequency transformer. This is absolutely necessary to by-pass the necessary radio-frequency currents from the plate of the first tube past the transformer instead of through the high resistance windings.



Harkness reflex circuit with one stage of a. f.

Mr. M. L. Lyon of Santiago, Cal., is troubled with a persistent whistling noise in his receiver. He uses a regenerative detector and two stages of audio-frequency amplification.

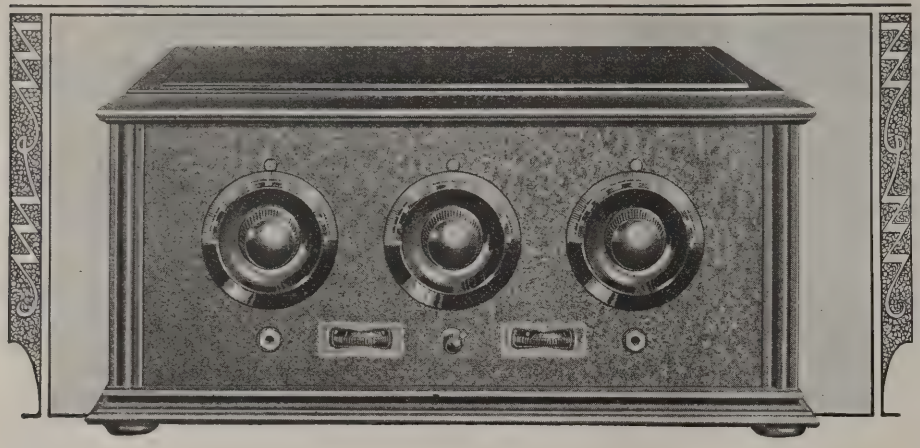
The fact that the pitch of the whistling is in any way affected by the tuning of the receiver indicates that it is due to oscillation of the amplifier tubes. This oscillation is caused by coupling the stages through stray capacity in the leads or through the inherent resistance of the "B" battery which, of course, is connected to the plate circuits of both steps. This latter coupling is the most frequent cause of audio-frequency oscillations and can generally be remedied by connecting a 2 mfd. condenser across the "B" battery. If the two transformers be moved further apart this will also help in eliminating the whistle.

Mr. Herman Reisman of New York City, wishes to know which we would recommend for use with a "D" coil receiver, 201A's in the amplifier and a UV-200 in the detector or all 201A's.

We believe that it would be more satisfactory to use the UV-201A's throughout as this will considerably lessen your filament drain. Using the UV-200 the total drain from your "A" battery will be two amperes and from your "B" battery 34 milliamperes. Using all 201A's the "A" battery drain will be only 1¼ amperes and from the "B" battery only 28 milliamperes. This was found to be true by actual test in our laboratories. Mr. Reisman goes on to ask if 23-plate .0005 mfd. variable condensers can be substituted for the .001 mfd. as suggested. The 23-plate variable condensers will tune to the entire broadcasting waveband and even the .0005 mfd. 13-plate condensers can be used providing the number of turns is changed to 12 in the primary and 60 in the secondary.

EISEMANN

ELECTRICAL EQUIPMENT



Announcing the 6-D Receiver

TYPE 6-D embodies the most modern developments in radio engineering, together with unusual design and workmanship. It meets the most exacting requirements of discriminating buyers.

The outstanding characteristics of this new Receiver are extreme selectivity, extraordinary distance range and exceptional clarity. Tuning is very simple. The 6-D is a non-oscillating Receiver, and no potentiometer or stabilizer is employed.

Step into a radio store and examine this new Receiver. Ask for a demonstration, and see for yourself its many superior qualities.

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification.

Tubes: Five in all. Jacks provided for either five or four tube operation.

Batteries: Either storage or dry-cells.

Cables: Complete set supplied for "A" and "B" batteries.

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Aerial: 75 to 125 feet, single wire.

Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Rheostats: Adequate resistance for all standard base commercial tubes.

Condensers: Single bearing, low leakage losses.

Sockets: Suspended on cushion springs which absorb vibrations.

Cabinet: Mahogany, with distinctive lines and high finish. Ample space provided for "B" batteries.

Price, Without Tubes and Batteries, $125.00

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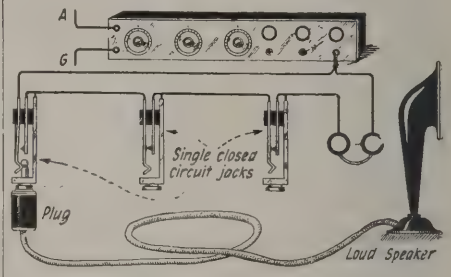
Information Desk

(*Continued from page* 71)

Mr. R. E. Cochran writes: "Having noticed on the market a device which enables one to use the house current in place of 'B' battery I would like to know if you can supply me with a circuit and list of parts needed to construct this which will eliminate the very pronounced hum which is present in all lighting circuits."

A device has recently been brought out by the Sabin Electrical Products Co. and was written up in the July issue of THE WIRELESS AGE which can be used either with direct current or alternating current. It is quite impossible for the layman to build such a converter as it requires certain thermo elements which are quite out of the ken of the average person. We would advise the purchase of such an instrument rather than the attempt to personally make one. Incidentally it might be stated that this device has proven satisfactory.

Mr. B. A. Farrell of Atlantic City, N. J., writes: "After reading your last issue I see that it is possible to connect several apartments with one receiving set. I would like very much to get information pertaining to this together with wiring diagrams."



We are reprinting here a circuit diagram which appeared in the June issue of THE WIRELESS AGE representing the use of one radio set to furnish entertainment to several rooms and which can be elaborated to furnish a whole apartment house.

Mr. W. J. Haas of Zion, Ill., writes: "Will you please send me detailed diagram of the panel layouts for the 'D' coil receiver which was published in the June issue of THE WIRELESS AGE."

In the October issue of this magazine there will be reprinted the circuit diagram of the "D" coil receiver together with a panel layout for drilling the holes and the placing of the instruments. The "D" coil receiver has met with such unprecedented favor among our readers that we feel obliged to run another descriptive article on what the receiver has done. Several new ideas on the tuning of the receiver and little hints which our readers have sent us will be incorporated with this article.

Walter G. Bailey, Bremerton, Washington writes of his experience with the "D" coil receiver. "I find upon calibration of my set that it tunes from 435 meters to 800 meters. I have not changed it as yet as I thought I would write you and get your opinion of it. I have tried it out upon an outside aerial 100 feet long."

It seems incredible that your wavelength range should be from 435 meters to 800 meters. If the coils were wound correctly,

Ultradyne Kit

Consists of 1 type "A" Ultraformer, 3 type "B" Ultraformers, 1 Tuning Coil, 1 Oscillator Coil, 4 matched fixed Condensers.

The Ultraformers are new improved long wave radio frequency transformers, specially designed by R. E. Lacault, Consulting Engineer of this company and inventor of the Ultradyne.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. Ultraformers are guaranteed so long as this seal remains unbroken.

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Send for the 32-page illustrated book giving latest authentic information on drilling, wiring, assembling and tuning 6 and 8 tube Ultradyne Receivers.

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Selectivity

WDAR—PHILADELPHIA—395.
12.02 P. M.—Arcadia Concert Orchestra; organ recital.
2.00 P. M.—Arcadia Concert Orchestra.
5.15 P. M.—Dance music.
7.30 P. M.—Dream Daddy.
8.00 P. M.—Palestrina Choir and soloists.
10.00 P. M.—Features from Fay's Theatre.

WDAF—KANSAS CITY—411.
5.30 P. M.—Musical program.
10.00 P. M.—Dance music and comedy.
1.45 A. M.—Nighthawk Frolic; Coon Sanders Orchestra.

PWX—HAVANA, CUBA 400
7:30 P. M.—Bedtime story for the kiddies; Hotel Kimball studio, Springfield.
7:40 P. M.—French Night at the Hotel Kimball studio; program to be announced by Attorney David Lavigne.
8:30 P. M.—Concert by Laurilla Baillargeon, soprano; [illegible] Janson La Palme, baryOrchestra, 7.15; popular songs, 8.45.

WOR (405 Meters).
5:00 P. M.—Alabama Five; vocal and instrumental ex-service men under direction of Professor Gray.
5:30 P. M.—Continuation of program by Anna Barwig, soprano. Program—"The Rosary," "Nocturne," "Light," "Four-leaf Clover."
5:45 P. M.—Piano solos by Lillian Dell.
6:15 P. M.—"Music While You Dine"—

WEAF (492 Meters).
4:00 P. M.—Bob Fridkin's Clifford Lodge Orchestra.
4:[illegible] P. M.—Marjoria Fullerton, coloratura soprano, accompanied by Eleanor Owens. Program—"Hist! Mrs. Piper" (Curran); "The Giraffe" (Kraer); "If No One Ever Marries Me."
4:50 P. M.—William F. Sweeney, baritone, accompanied by Winifred T. Barr.
5:00 P. M.—Women's program under the auspices of the Women's League of the

—A Dominating feature

An Ultradyne receiver operating in New York City easily tunes out the powerful broadcasting of WOR, Newark, N. J. —405 meters and brings in WDAR, Philadelphia—395 meters; PWX, Havana, Cuba—400 meters; WDAF, Kansas City—411 meters.

Regardless of close similarity in wavelength, the Ultradyne selects any station within range—brings in broadcasting clearly, distinctly, faithfully.

The "Modulation System" of radio reception is used exclusively in the Ultradyne. It is the latest achievement of R.E. Lacault, A.M.I.R.E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

The "Modulation System" increases the sensitiveness of the Ultradyne over that of any known receiver. Weakest signals are made to operate the loud speaker.

In addition the Ultradyne incorporates every good feature of the famous Super-Heterodyne.

Ultradyne performance is the envy of the radio industry

Write for Descriptive Circular.

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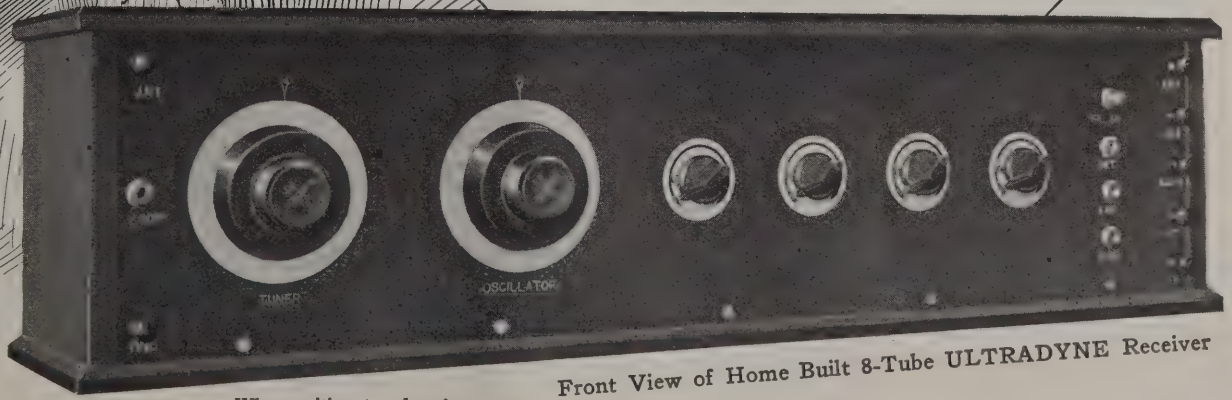

Front View of Home Built 8-Tube ULTRADYNE Receiver

that is, 10 in the primary and 40 turns in the secondary, we cannot understand how such a wavelength range could be had. At any rate the minimum wavelength would have been nearer 200 than 400. There must have been some mistake in the matter of winding turns on. If you have three 23-plate variable condensers handy, we would recommend that you substitute them for the .001 mfd. and see if this will bring your wavelength range down. In the diagram there was no post shown for the negative of the "B" battery. This should be connected to the positive "A."

We would be interested to learn how your friend was able to calibrate this receiver from a buzzer signal on a wavemeter and yet when it is placed on an outside antenna it will not bring in signals.

Another thing—a hundred foot antenna is not quite enough for such a circuit with an untuned primary, particularly for distant reception. About fifty feet could be added to this without endangering the selectivity.

Mr. H. F. Tyson writes that he has constructed THE WIRELESS AGE *"D" coil receiver and substituted for the .001 mfd. variable condensers the 23-plate size, as he was unable to procure the former. What changes should be made in the windings of the coils?*

In order to tune from 220 to 550 meters with a 23-plate condenser you should have about 50 turns in the secondary winding of each transformer or "D" coil. No change is necessary in the primary winding. Using 50 turns on the secondary the receiver will then tune to your broadcast waveband without difficulty.

Bertram Heiser of Detroit, Michigan, says that "I can get no results from my receiver until the third condenser is placed at five degrees or less. Then there is heard a constant oscillation such as is given off by a regenerative receiver. I have checked over the diagram several times but can find nothing wrong unless it be wrong connections in the astatic transformers."

The astatic transformers should be so placed in respect to each other that the cross windings through their diameter are in a straight line and parallel to the panel. Unless they are in this position the fields do not oppose each other and consequently there is intertransformer and interstage coupling, producing uncontrollable oscillation. We advise this change and if necessary the reduction of the "B" battery voltage on the radio-frequency amplifier. Be sure that the minus "B" is connected to the positive "A" for best results.

Elmer G. Jayne of Providence, R. I. writes: "Following the instructions in the June issue of THE WIRELESS AGE *I constructed the McIlvain receiver. There is evidently something wrong in my connection as I have been only able to hear KDKA in Pittsburgh and WGY in Schenectady. I used Radiotron UV-201A tubes in the amplifier and UV-200 in the detector. Will a UV-201A in the detector also be of any benefit?"*

The reason you do not hear more stations with this receiver is probably due to your inexperience in tuning. Your reception of Pittsburgh alone proves that the set is working properly. A UV-200 in the detector socket will probably prove more sensitive than a UV-201A, and we would recommend it if storage battery consumption means nothing to you. By using five UV-201A's the drain from your "A" battery is about ½ that of four UV-201A's and a UV-200.

Correction

A STATEMENT made in these columns in the August issue that the WD-11's and WD-12's were not designed for radio frequency amplification and therefore cannot be expected to do this well was somewhat misleading. This may have applied to the old type because of the internal capacity of the tube. The present models, with the small 4-wire press and the moulded base, have a low inter-electrode capacity and are just as satisfactory for radio-frequency amplification as for audio.

Radio Shows

THE New England Exposition Service Co. of 196 Worthington St., Springfield, Mass., are promoting two radio shows to be held this Fall, one in Hartford, Conn., and one in Springfield, Mass.

Mr. J. P. McMahon the general manager of these two shows who is co-operating with the Radio Dealers' Association in each city has announced the date of these shows as follows:

Oct. 4th to 11th—Hartford, Conn., at Foot Guard Hall.

Oct. 27th to Nov. 1st—Springfield, Mass., at the Auditorium.

Not a makeshift—but a real Loud Speaker *with the famous "Manhattan Concert Modulator"*

IT'S not a makeshift—it's not just a headset in a horn—but a real loud speaker that reproduces all radio programs with excellent musical quality.

The Manhattan Junior has a reproducing unit especially and correctly designed to operate the long air column of the horn. The diaphragm is large and heavy—firmly locked in place—no rubber is used. The permanent magnet is extra large—and no batteries are required for operation.

It has a Concert Modulator

The Manhattan Junior is the only loud speaker in its price class to have that most necessary adjustment—the "Concert Modulator." By means of it, the instrument can be satisfactorily accommodated to set, tubes and the strength of "B" battery current, so that the best results can always be obtained. It also eliminates any possibility of "chattering" caused by overloading from powerful receiving sets.

Hear the Manhattan Junior demonstrated at your nearest dealer—its musical qualities will astonish you.

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Manhattan Electrical Supply Company

New York Chicago St. Louis San Francisco

Manhattan Junior $10

A REAL LOUD SPEAKER WITH A "CONCERT MODULATOR"

The ARISTOCRAT OF AMPLIFIERS

Quality in Radio is No Less Marked Than Quality in People. The Resistance Coupled Amplifier is a Quality Product.

DAVEN COMPLETE AMPLIFIER KIT

3-stage $13.50
4-stage 17.00

KITS without sockets and condensers

3-stage $8.50
4-stage 11.00

Read "RESISTORS, THEIR PRACTICAL APPLICATION IN RADIO RECEPTION."

By Zeh Bouck.

Price 15c

Also read, "THE HOW AND WHY OF RESISTANCE COUPLED AMPLIFICATION."

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These booklets may be obtained from your dealer.

DAVEN RADIO CORP.
"Resistor Specialists"
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—And the High Gloss is Everlasting

A beautiful black, high gloss finish is but one of the superior features Spaulding Bakelite-Duresto panels can offer you.

Bakelite-Duresto panels drill and engrave easily without chipping. Will not warp, shrink or split. Highest in dielectric strength. The best that money can buy. Insist on Spaulding Bakelite-Duresto. Your dealer will cut and drill it for you.

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In Wireless Communication

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The best text book on the market devoted solely to the various applications of the Oscillation Valve

Price, $1.75

THE WIRELESS PRESS, INC.

326 BROADWAY NEW YORK

The Second Shot?

(*Continued from page 33*)

fense, I could have got you off, perhaps."

"But I didn't fire a shot. There was no second shot," persisted the prisoner doggedly.

So matters stood at the beginning of the week before the date set for Lewis's trial. Public interest had already lost its keenest edge. His conviction was a foregone conclusion.

Then another bombshell was burst, right in the district attorney's office and under that officer's very nose. A clerk entered the district attorney's private office and said, "There's a nut out here says he's got some new evidence in the Dunellin murder. Says he's got to see you."

"Oh, very well," sighed the district attorney. "Show him in."

"Nuts" were a part of his daily routine, but then, you never could tell.

A ruddy-faced middle-aged man of the traveling salesman type entered.

"Name's Sayre," he announced. "Traveling for Kelly Bros., wholesale groceries, been out on my territory ever since the morning after Dunellin was shot. Just got back. Been hearing a lot about it today for first time. Don't read the papers much. I'm a radio fan. Get most of my news by radio.

"Now, listen. Only one shot was fired that night, and I can prove it."

"If you can, you'll save Mr. Lewis's life," the district attorney said, still unimpressed. "But how?"

"Well, first, I heard that shot myself over the radio in my own home. I'd been sitting listening to the meeting all the evening. When the meeting closed I didn't get up for a while to shut off my apparatus. I could hear the voices of the crowd goin' out, trampin' of feet and all, real plain. Then it got quiet, and pretty soon I heard two voices, couldn't hear what they said, but they was earnest. Then all of a sudden there was a loud crack in the horn like a pistol shot, just one. I thought it was something to do with the static and thought nothin' of it. But now I know it was that pistol of Dunellin's. Lewis had forgotten to turn off the radio when the meeting closed."

The district attorney was interested at last, but still skeptical.

"All very well as far as it goes," he agreed, "but you are only one witness. We have five equally competent witnesses who swear they heard two reports. If you can prove them liars, I'll have the indictment of Lewis quashed at once."

"Oh, they wasn't liars," Sayre interjected. "They heard two reports, all right. I can prove they did. But there was only one shot."

"An echo, you mean? We proved there was no echo."

"No, I don't mean an echo. Tell you what you do. You meet me in half an hour at the trolley stop where those witnesses heard the two reports. I know that spot, been getting my radio supplies at the little store there. Bring along an officer with a gun and blank cartridges."

The district attorney finally agreed, impressed at last by the man's intelligence and earnestness.

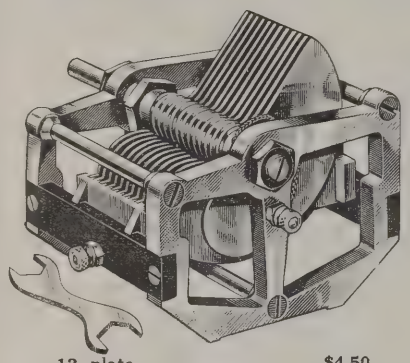
They met at the appointed place right at the curb opposite the corner of the little general store, where the Senator and his companions had stood when the shot was fired. Looking past the store door diagonally across the square they faced the theatre.

"Now, Mr. District Attorney," Sayre directed, "I'm acquainted with the theatre management and made arrangements to have your man here go into the manager's office and fire a blank in front of the open window every time you wave to him."

When the man was stationed the district attorney gave the signal. Two sharp reports came from the theatre. The district attorney looked nonplused. He tried it again, then again and again.

"I wonder if he's firing two shots each time," he demanded. "Is this a hoax?"

Do You Want Improved Reception?



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No matter what circuit you're using this condenser will improve it. This product is electrically perfect and mechanically beyond comparison. The only low-loss condenser that gives real straight line wave length. Better and simpler tuning.

Examine it at your dealer's. Write for "20-point" folder; it gives the details.

Bremer-Tully Leads Again
With real low loss tuner

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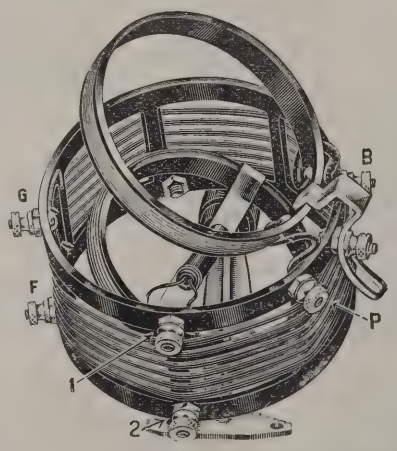

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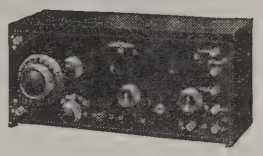
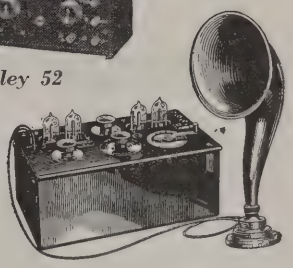
Easily Sold—and a good profit for you

Radiola III-A and the Crosley 52 receivers are two of the leading low priced sets now in demand. Radio dealers have found that these sets sell easily—and bring in return real profits.

Standard Receivers such as the popular Crosley 52 and Radiola III-A are nationally advertised and displayed. The manufacturers of these two receivers are spending time, effort and money to help dealers sell sets. Tie up with the worth while products and find out how easy it is to sell Radio the year around. Quick turnover always means profit.



Crosley 52



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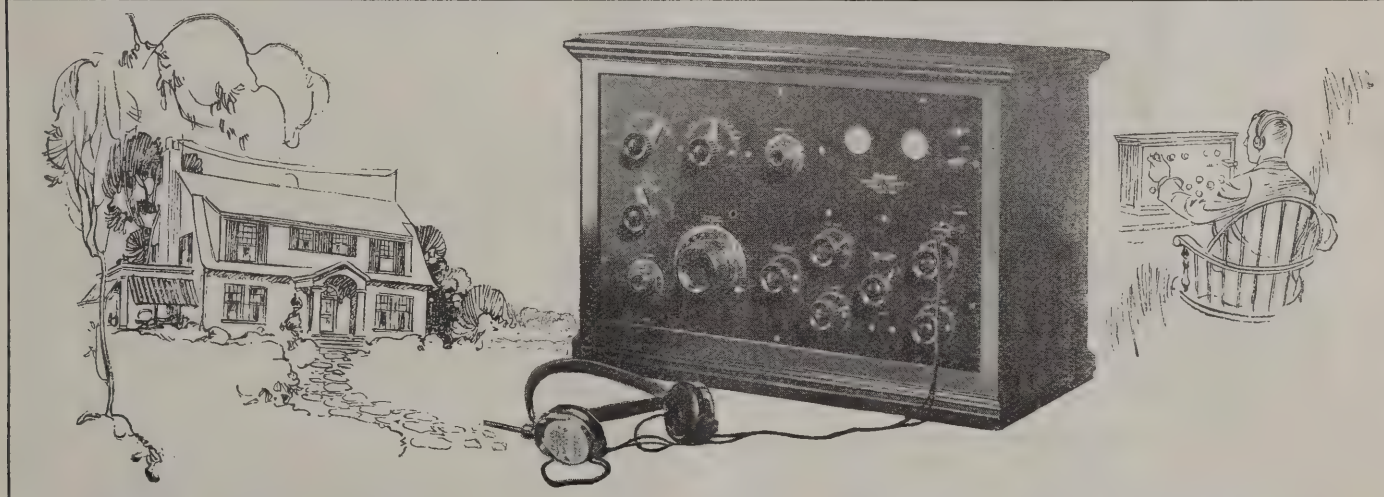

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With headphones.

For loop reception (No. 61)

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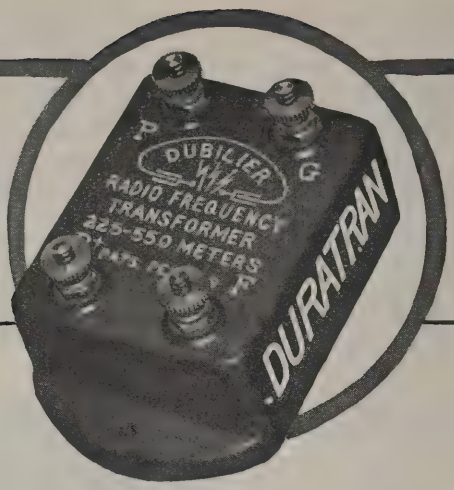

Get those Stations with the DURATRAN!

You can get them on your home-made set—even if you are handicapped by an indoor loop. You can get them clear and strong. Only one thing is needed—the right radio frequency transformer—*the DURATRAN!*

Powerful! The Duratran picks up all standard broadcasting wave lengths—not just a narrow band but the entire band of 225 to 550 meters. And amplifies as much as *20 times*. Yet the reception is clear, undistorted, full!

Don't discard your one-tube regenerative set because you can't get the distant stations. The Duratran, the wonderful radio-frequency transformer, will bring them in.

For real satisfaction use the Duratran $4.00

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A six-tube radio set, completely self-contained. Does not need to be opened to operate. Write today for full particulars and name of nearest dealer.

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20FT MAST PREPAID $10

Install this steel aerial mast for greater range and better results. NEAT SUBSTANTIAL CONSTRUCTION. PRICE, $10. PREPAID IF REMITTANCE IS SENT WITH ORDER—OTHERWISE C. O. D.

S.W. HULL & CO. 2048 EAST 79th STREET
CLEVELAND, OHIO

"No," Sayre assured him. "If he fired two shots you'd have heard four."

"Well, what's the explanation?"

Sayre put on the air of a lecturer.

"I read in my radio magazine a spell ago that a radio wave travels so fast it's practically instantaneous. But sound travels through the air only a little over a thousand feet a second. It's a good 1,500 feet from here to that theatre. In other words, if you stood here and listened to a sound at the theatre over the radio, you'd hear it a second quicker at least than it could reach you in the open air. Then when it reached you through the air you'd hear it again.

"See that radio horn up there?"

Sayre pointed to a horn sticking out over the door of the little general store, right in line between them and the theatre.

"They broadcast the mass meeting to an overflow here all the evening the night Dunellin was shot and the boss hadn't turned his horn off yet at the time of the shootin'. The first shot those witnesses of yours heard came to them instantly over the radio. The second one that you're tryin' to pin on Lewis was the report of the same shot comin' on through the air by freight a second or so later."

Within an hour the district attorney took steps to have the indictment of Martin Lewis quashed.

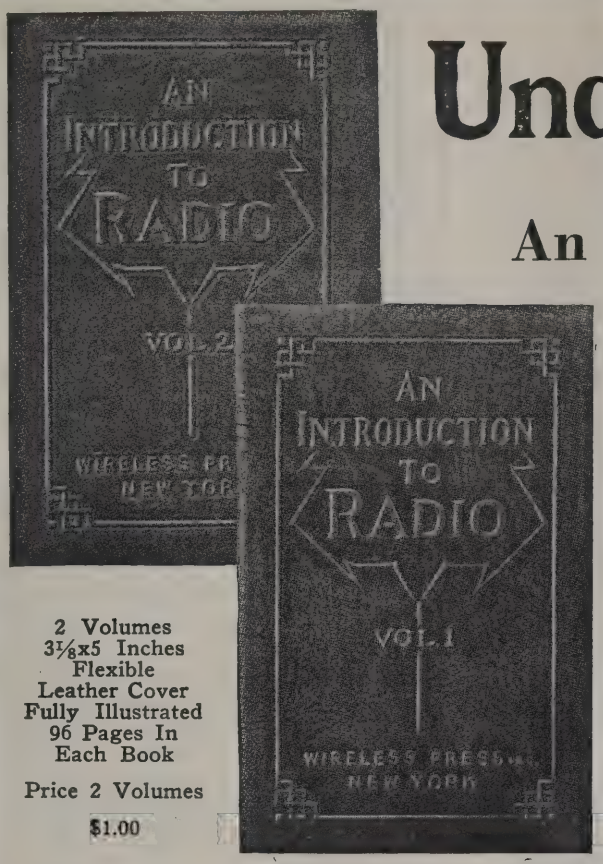
Oscillation Controlled R. F. Receiver

(*Continued from page* 54)

wiring diagram exactly. Even with the expert builder of sets it is difficult and often impossible to determine the exact cause of trouble after the set has been wired up. If you already have a detector and two stage audio frequency amplifier that is available, it, of course, may be used in connection with this set and it will simplify construction very much. However, if you wish the complete set behind one panel the list of materials includes these parts. Do not use any shields in making this set as there is no need of protection against body capacity effects. With these excellent condensers the need of any such shielding is obviated. Make all your connections firm and clean using great care that no soldering paste or flux spreads to any apparatus. Be sure also that your connections are not "soldered" with paste instead of solder. Keep all the grid and plate wires well separated. When the set is completely wired connect up the batteries to the binding post on the terminal strip in the rear.

Adjustment of Transformer Angles

The following procedure is necessary to determine the proper angle at which the three radio frequency trans-



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ANSWERS YOUR QUESTIONS—Every novice in radio always asks the same questions: What is a radio wave? How is it made? How long does it take to get to me from the broadcasting station? Is there any difference between the dot and dash waves and the music waves? What is a condenser for? What is a variometer? What is the difference between a variocoupler and a loose coupler? How are the ear phones made? What does the crystal detector do? How does a vacuum tube work? What is the grid leak for? Is there any danger that my antenna will be struck by lightning? How can I tune my set to get the loudest signals? What is the difference between radio frequency and audio frequency? What is a potentiometer for and how does it differ from a rheostat? And scores of other questions. All are answered in this book.

Make no mistake. This is a non-technical book. All who can read English can understand it. Funny how hard it is for an expert to talk shop so everyone can understand—there are a number of good technical books, but this is the best book we have ever seen of the hardest kind to do well.

An introduction to Radio. That is just what it is. Mr. (Miss or Mrs.) Reader, we take great pleasure in introducing Radio. After a few hours you can meet the other members of the family and talk radio with them as you can't now.

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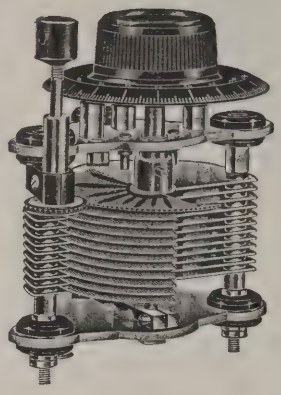

OLD fashioned dielectric end plates (insulating material) which waste condenser efficiency just as leaky piston rings waste gasoline, completely discarded in the new HEATH CONDENSERS. Grounded end plates of aluminum entirely do away with the old difficulties of dielectric loss and warping of plates. No shielding necessary. All metal, except for the small pieces of hard rubber in the end plates which separate the rotor from the stator plates. Therefore extraordinarily rigid—*Minimum Loss.*

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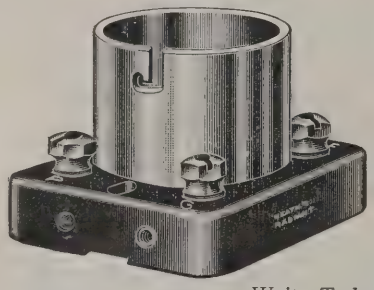

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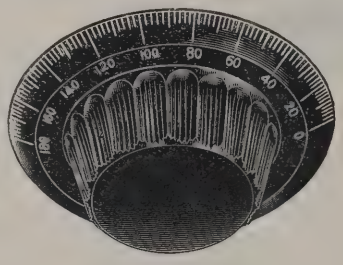

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formers should be set. Adjust C4 so that the dial reads 20, tune in a strong signal, preferably the readings of 15 to 20 on C2 and C3. Keep both transformers No. 1 and No. 2 approximately parallel to each other. Vary the angle carefully until no oscillation beat, which may be a whistle or click, can be heard when crossing the signal with dial C1, that is, when rotating the dial back and forth. When the angle is properly adjusted and C4 is placed at 0 no oscillation will occur in any wavelength. Transformer angles, however, should be kept as near vertical as possible. Bind the transformers down toward the horizontal just enough to stop oscillation with C4 adjusted to 0. When this adjustment is made the receiver is operating at its most sensitive and stable condition. Control C4 should be rotated toward 100 for increased signal strength which should always be adjusted below the point where distortion or a peculiar type of regeneration occurs. This adjustment of C4 may require a preliminary readjustment of tuning dial C2. When hunting for stations adjust C1, C2 and C3 to the same reading. Using both hands rotate C2 and C1 very slowly keeping their readings the same and following each adjustment with a readjustment of C3. In order to interpret the results of this receiver, it is necessary to recognize the sounds which you hear in your receivers. When a circuit is oscillating a beat or whistle will be heard which will vary from a high pitch to a very low pitch as the receiver is brought to resonance with the signal and again from low to high pitch as you pass the signal. Do not confuse this with a beat or whistle of unvarying pitch which cannot be changed in pitch by rotating C1 and C2. This is caused by external transmitters.

Distributed Capacity of Radio Receiver Coils

(*Continued from page 62*)

This method invloves much less work and computation than the one generally recommended which requires plotting a curve between the wavelength and the resonance capacity squared, and extending the curve until it crosses the axis.

To illustrate these methods the following measurements were made on a receiving set tuning coil having 93 turns of No. 20/38 litz on a 2.25 inch tube. The method making use of the cross sectioned paper is shown in figure 2.

$-\lambda$	λ^2	Cap.
231	53360	43 MMF.
300	90000	65.5
400	160000	$111.=C_2-$
800	640000	$474.=C_1$

Learn the Code at Home with the Omnigraph

"Just Listen—The Omnigraph will do the teaching"

THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed from 5 to 50 words a minute. **THE OMNIGRAPH** is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. **THE OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact the Dept. of Commerce uses **THE OMNIGRAPH** to test all applicants applying for a Radio license. **THE OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

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SUPER TRANSFORMER
(audio frequency)

The Mirror of the Broadcasting Studio

"Why, Charles, that musical reproduction is perfect. Can that be our old set? It looks the same but how different it sounds. We were never able to get such perfect music before. It seems as though the artists were right here in the room. What *have* you done?"

"Simplest thing in the world, Mary. The boys at the office have been talking Thordarson Amplifying Transformers so hard that I decided to install them in place of my old ones. I see now that it was a wise move."

* * *

The Super Transformer is indeed the mirror of the Broadcasting Studio. It was designed with one primal aim—perfect reproduction. It has the same function in a radio set that the reproducer has on your phonograph. Install a pair—it will take you but a few minutes—and you will marvel at the rich musical quality obtained.

Kennedy, Zenith, Radiodyne and many other leading set manufacturers use the Thordarson Super Transformer in their apparatus. That's irrefutable proof of Thordarson superiority.

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Get all the fun there is to be had from your wireless set.
Learn to read dots and dashes and double your pleasure.

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It is noted that both of these methods give the same results within the experimental error.

The first three measurements plotted on cross section paper, as in figure 2, intersect the capacity axis at 10 micro-microfarads, indicating that the coil has a distributed capacity of that amount.

Utilizing the method disclosed in the above description results as follows: the oscillator was set at 800 meters and the capacity required to tune the coil to resonance was found to be 474 mmf. The first harmonic of the oscillator was found with a capacity of 111 mmf. Then according to the formula:

$$C_a = \frac{474 - 4 \times 111}{3} = 10 \text{ mmf.}$$

"Selling" the Movies by Radio

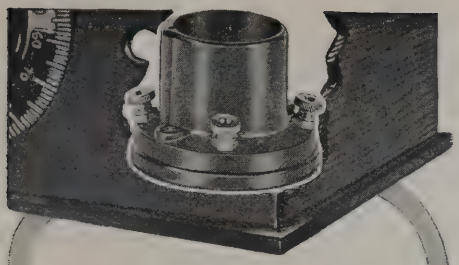
(*Continued from page 37*)

For many years I have been dealing with the general public in my newspaper and theatrical associations, but I have never encountered such spontaneous audiences as are made up of radio listeners. They are positively Pals. At least I found them so and when dozens, I may say hundreds, wrote me asking that I induce some of the film stars of my acquaintance to appear before the microphone, I was happy to comply with their requests.

One of the first of the well known stars whom I approached was the world's premier comedian, Charlie Chaplin. I sought him out in his luxurious suite in the Ritz Carlton Hotel, New York, where he was staying for a few days while negotiating contracts with the firm that distributes his pictures throughout the world. Charlie greeted me cordially and it may be of interest that by actual count there were 31 newspaper reporters and special writers in his reception room which was flanked by cameras. Before his smile of greeting faded, I quickly sprung on him the idea of making a radio talk. If there are among my readers any who know Chaplin even casually, they at least, will appreciate the effect such a request had upon the celebrated fun-maker. He was nonplused.

In all my acquaintance there is no more modest person than the immaculately attired, gentlemanly, diminutive Englishman whom the theater-going world knows as a clown de luxe. Retiring is not the word for he is positively shy. As he started his alibi I was fortified by the composite spectre of those hundreds of thousands of my radio Pals who would welcome news of a talk broadcast by Chaplin.

Briefly, he finally agreed to journey over to WOR at Newark, N. J., and it will be an added compliment for



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Are the contacts in the sockets of your radio set easily accessible for ordinary and necessary cleaning?

With Na-ald DeLuxe Sockets in use you need neither sandpaper or an extra reach to keep contact strips and tube terminals bright and clean.

Just rotate the tube three or four times. Instantly the dual-wipe laminated contacts remove corrosion, making a bright perfect connection. This action is on the side of the tube terminals away from the soldered ends. *"It's the contact that counts."*

Make your Superheterodyne set free from socket trouble by using Na-ald De Luxe Sockets.

Sockets and panel mounts for all tubes. Prices 35c to 75c. Send for catalog.

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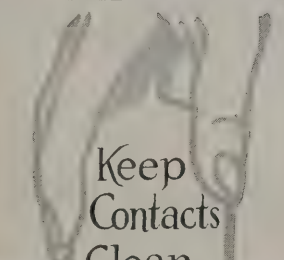

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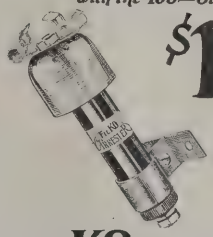

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Simple-Sturdy-Sure

50¢

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New! Remember—These parts are new this season! Be Sure to see them at your dealer's.

Improved Reception

The One Big Thing in Radio That Interests *Everyone!*

Improved Reception Through "Tube Tuning" with a Scientifically Correct Radio Rheostat.

There have always been plenty of rheostats that served to open and close the "A" battery circuit, but until the Fil-Ko-Stat was made it was impossible to adjust the filament heat to the most efficient operating point, giving maximum audibility in phones or loud speaker. Only the Fil-Ko-Stat, designed to give improved reception, allows infinite control of filament current, making possible louder, clearer signals from distant and local stations in any Radio Receiver using any type of tubes. And now—the NEW model (*insist on the NEW model at your dealer*) gives even finer control than ever before. It's $2 including the battery switch attachment. And it's unconditionally guaranteed.

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Likewise, there are many forms of grid leaks, some variable, others fixed. The Fil-Ko-Leak, however, is the only grid leak that can be set for a *specified* resistance and adjusted for best results. It's hand calibrated (and double checked) over the operating range for all tubes—¼ to 5 megohms. Markings can be read through a panel peep-hole, and it's also equipped for table mounting [bracket packed with each instrument]. Guaranteed perfect electrically and mechanically, it gives scientifically correct control of grid potential —for $2.

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Even were the Fil-Ko-Lightning Arrester no better than the average, it would still be worth far more because it comes to you with a guarantee that is virtually an insurance policy. You get $100 or we repair or replace your set if damaged through fault of the arrester. But the Fil-Ko-Arrester *is* better. It eliminates all leakage losses from aerial to ground, all radio impulses reaching the antenna are sure to pass through your radio set, insuring maximum reception. Hermetically sealed *Bakelite* insulation is protected by an umbrella-shaped shield that keeps off dust, moisture and other conductive matter. You get positive protection for $1.50.

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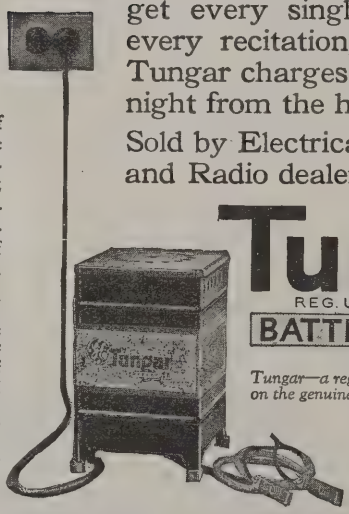

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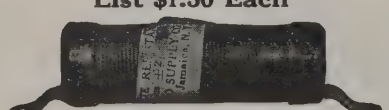

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The Traffic Cop of the Air

He arranges in orderly fashion the mass and jumble of Broadcasting Stations that are seeking entrance to your set and brings 'em in, one at a time, so you can enjoy them! Never reduces, but nearly always increases volume. Add a Ferbend Wave Trap to your set and "Police" your reception. Regulate the Traffic!

Guaranteed to tune out any interfering station. The price is $8.50. Shipment is made parcel post C. O. D. plus a few cents postage. If you prefer, send cash in full with order and we will ship postage prepaid. Send us your order today.

FERBEND Wave Trap
FERBEND ELECTRIC COMPANY
18 E. South Water St. Chicago, Ill.

radio listeners to learn that Chaplin's radio talk was his only public "appearance" or utterance while he was in the East and it was his microphone début.

He declined more than 600 invitations from a diversity of sources, many of which it would have been an investment for him to accept; but he did entertain the radio audience and I had the honor of introducing him to you all.

Baby Peggy is another of Filmdom's elect who first addressed the radio Pals under my auspices. Of course she is a darling, and I might fill several pages telling of intimate experiences with this wonder child of fame and fortune. Just one incident will suffice to illustrate her unspoiled sweetness and childlike simplicity.

My daughter, Angela, Baby Peggy and I were en route to the radio station the day following Peggy's fifth birthday. Both kidlets were huddled in a corner of the huge motor and were inclined to be sleepy. To keep her fit for the imminent radio talk, I was chatting away and casually asked Peggy, "How old are you, dear?" She answered, "Mr. 'Tosker, I'm just done being four." How I hope she will never be done being her own sweet little self and I do feel that she will always be so!

Dick Barthelmess, Conrad Nagel, Miriam Battista, Mabel Normand and Marion Davies are among well known screen favorites I have presented to the radio fans and the long list includes such personalities as, Owen Moore, Claire Windsor, Bryant Washburn, Lou Tellegen, Mickey Bennett, Tom Terris, Elliott Dexter, Kenneth Webb, Charles Ray and ever so many others whose names are literally household words.

I get a lot of fun and much satisfaction out of my radio work. I have endeavored to put a flavor of humor into the talks on current motion pictures. Also, as in every human endeavor, pathos has bobbed up at times. A pathetic incident of my radio work was made known to me in a letter I received from the matron of a home which houses nearly 700 blind persons. This good woman wrote me that the prayers of her afflicted charges had recently been offered for my success because my radio talks were the only existing link between them and the motion pictures. Another letter, this one carrying a smile, was received from an indulgent mother who wrote inquiring where she might purchase for her boy, a cap such as the movie cameramen wear, "one with the peak in the back."

So you see, behind the scenes of a big radio studio, are to be encountered the same lights and shadows that you, my radio Pals, out there on the air, are daily grinning and bearing.

THE NEW HOWARD 5-TUBE NEUTRODYNE

This remarkable Set has created a sensation. Beautiful black walnut cabinet—special Howard parts throughout and guaranteed to give excellent results.

WRITE TODAY FOR FULL DESCRIPTION AND PRICES

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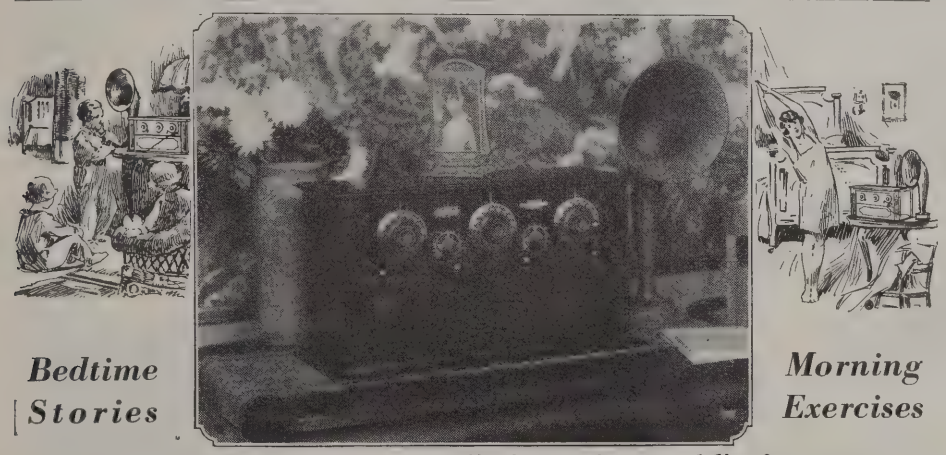
Req. U.S. Pat. Off. NEUTRODYNE Req. U.S. Pat. Off.
Pat. March 27, 1923 and April 1, 1924.
Hazeltine Pats. Nos. 1,450,080 and 1,489,228
Other Patents Pending



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WHEN you own a Radiodyne the world's foremost entertainers and educators serve you. With this efficient receiving set you can bring operas, sermons, lectures, dance music, etc., right into your home clear and distinct on loud speaker no matter where broadcasted or where you live.

Uses Light Socket for Antenna

RADIODYNE

Outside or Inside Aerial for Daytime

"I have no outside antenna. I just plug into the light socket. Picked up Omaha last Sunday morning at ten o'clock when the temperature was 95 and the sun shining."
Frank Williams, Winona, Minn.

"Received Cuba, Canada, New York and California on loud speaker with 70 foot ribbon antenna in attic. Also have a single 75 foot wire outside for daytime, volume and distance."
L. G. George, Fairmount, Ill.

Write for illustrated folder which describes the RADIODYNE in detail. Every radio fan will be interested in this new type receiver.

Western Coil & Electrical Co., 316 Fifth St., Racine, Wis.

Guglielmo Marconi, as he appears today. Signor Marconi is Honorary Chairman of the Radio Institute of America

Train for the big Jobs in Radio

There are big radio jobs waiting. Over 6,000 operators have already graduated from the Radio Institute of America. But the radio industry is just in its infancy. There are more demands for operators than there are trained men to meet the demand.

Conducted by the Radio Corporation of America, the Radio Institute offers the soundest instruction and the most logical means of employment after graduation. Write for information concerning our classes.

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Conducted from New York City. Full instruction for those who cannot attend our New York or San Francisco resident school.

A. *Complete* Home Study Course. From beginnings of magnetism through code and commercial practice. Prepares you for U. S. operator's license.

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Established 1909
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Watch for further announcements in all leading radio publications.

Improved Bristol Audiophone Loud Speakers—gives greater volume, is more sensitive and still maintains its round, full tone and its distinctive freedom from distortion.

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Manufactured by

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CARTER *"HOLD-TITE"* JACKS

Made in ten different Spring Combinations

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Note the construction of this jack—nothing like it on the market, no matter what you pay. Thousands of satisfied users will vouch for it.

Insist on the original—any dealer can supply

Perfect Insulation:
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Only the best insulation used.

Offices in Principal Cities
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Carter Radio Co.
1062 REPUBLIC BUILDING
CHICAGO

On the Side Lines of the Industry

(*Continued from page 67*)

THE Peerless Radio Corporation was organized by Mr. Walter J. Henry, who remains as president and chairman of the board. Mr. Henry for the last five years has been general manager of the Wireless Specialty Apparatus Co. of Boston, one of the companies affiliated with the Radio Corporation of America.

Associated with Mr. Henry in his new venture are two of his former associates in the Wireless Specialty Company, Mr. W. E. Watrous, formerly production manager there, and Mr. Victor E. Rosen, formerly of the engineering department. The treasurer of the Peerless Corporation is Mr. C. N. Taylor, who is also president of the Wellesley National Bank.

OF the really worth while booklets and catalogues published recently, the following may be had by addressing requests to THE WIRELESS AGE:

1. A new dial card for logging stations, designed by the American Hard Rubber Co. for the non-technical members of the family.

2. Personal instructions for home set builders, "Phusiformer Possibilities," published by the Pathé Phonograph and Radio Corporation. The cost of producing this booklet requires a charge of 50 cents, but is well worth it.

3. "Small Dry Cell 'A' Batteries for Portable Receiving Sets," written by W. A. Schulte and published by the Burgess Battery Company.

4. A long needed booklet on circuit resistance has appeared in attractive form as "Resistors—Their Practical Applications in Radio Reception." Zeh Bouck has handled this problem well, and the Daven Radio Corporation should anticipate a large distribution.

5. An example of just what ten cents will buy has been demonstrated in the booklet "Radio Receiving Set Trouble Finding" and the "Radio Receiving Set Trouble Chart," written by Edgar H. Felix, who is a contributor to THE WIRELESS AGE.

The booklet is divided into three parts: The first deals with maintenance problems; the second with mechanical and electrical troubles, discussed part by part; and the third with faults due to improper manipulation of the receiver's controls. Location of troubles is made quick and easy by means of the "Trouble Chart."

All of these booklets have been read by the editorial department of this magazine and are recommended to readers as valuable assets to satisfactory radio set operation. The booklets, for which a nominal charge is made, contain information that is worth the price asked. Booklets, catalogues, and literature are only reviewed when the contents are informative and merit comment.

Performance plus *Beauty*

Choose your panel for its insulating value as well as for its appearance.

MAHOGANITE
Radion Panels

give you both the supreme insulation and the beauty of polished mahogany. For Mahoganite is not a surface finish but a material which extends from one side of the Radion Panel to the other.

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Look for this stamp on every genuine *Radion* Panel. Beware of substitutes and imitations.

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Dials, Sockets, Knobs and Insulators:

At All Good Radio Shops or write to

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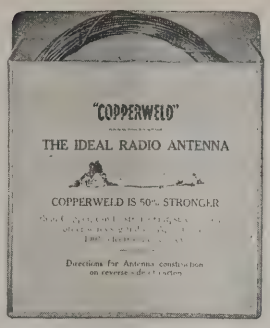
See our exhibit at the FIRST RADIO WORLD'S FAIR Madison Square Garden, New York SEPTEMBER, 22-28, 1924



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Strongest—Most Efficient—Best

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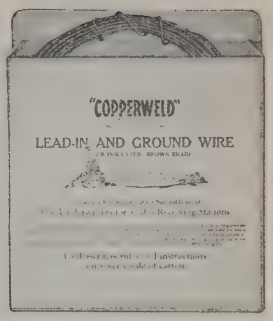
Rubber Insulated—Brown Braid
For inside and outside use



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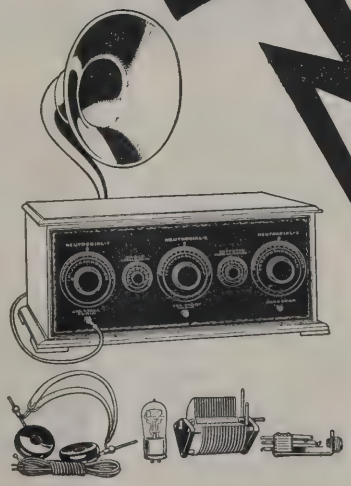

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The Worlds Largest Store owns and operates Station W.L.S. Wavelength 345 Meters. Tune in

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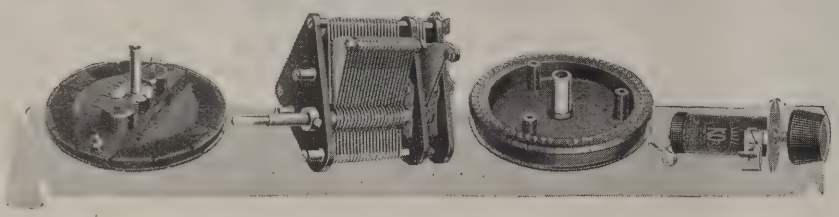

Standard Insulation —wherever Dials turn

With every facility for testing materials used in radio work, the United States Signal Corps chose Bakelite for the potentiometer base here shown. We also illustrate a Rogers Radiometer, Kellogg Condenser and Fil-Ko-Stat, all of which are Bakelite Insulated.

These critical radio experts, as well as the most inexperienced amateur, have come to recognize the phrase "Made of Bakelite" as a guaranty of excellence in radio insulation.

Bakelite enhances the value of any radio set. Its high electrical resistance, stability and beauty of finish have led to its adoption as standard insulation by the large majority of radio manufacturers.

Send for a copy of our Radio Booklet A

BAKELITE Condensite REDMANOL are the registered Trade Marks for the Phenol Resin Products manufactured under patents owned by BAKELITE CORPORATION

Send for our Radio Map

The Bakelite Radio Map lists the call letters, wave length and location of every broadcasting station in the world. Enclose 10 cents to cover the cost and we will send you this map. Address Map Department.

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Single Wire Antenna Effective for Transmission

By S. R. Winters

THE single wire antenna experimented with by the United States Shipping Board Emergency Fleet Corporation, consisted of four 7/8 phosphor bronze wires with four SE 165 insulators in each end. The design took the shape of an inverted "L." A trip from New Orleans to England with a one wire antenna on shipboard indicated that this new design of electric radiating system had an effective daylight range of over 200 miles, results which are responsible for the conclusion that the one wire antenna compares favorably with the three or four wire flat top design.

The most complete tests with respect to the one wire antenna were recently made at Boston. These tests included the various types of antenna embracing their operations over wave lengths of 450, 600 and 800 meters. In the course of these experiments the electric power was maintained as low as possible in order to avoid injury to gaps and keep interference with traffic at a minimum. The power determined upon was that which permitted a resonant condition with respect to the input of electric current, thereby yielding a clear note and the least amount of strain on the component parts of the apparatus.

Generally speaking, these transmission tests conclusively demonstrated the potential value of one wire as a means of radiating electric energy. The antenna in this instance consists of four strands of 7/18 antenna wire, formed into a cable in the absence of a manilla core. The omission of the latter was due to previous difficulties encountered in forming a single cable around a manilla core, which condition should suggest the possibility of a manufacturer producing a fabricated cable of this kind. Installation precautions were established by the insertion of a safety link consisting of one strand of 7/18 antenna wire between the safety strain insulators and the antenna. This arrangement was effected to avoid any possibility of broken topmasts in the event that this electric radiating system should become fouled with hoisting gear or grain fittings. By means of this provision, should the safety link break, the strain insulators would be held by the halyards, permitting the antenna wire only to fall. Thus the possibilities of injury to persons on deck are reduced to a minimum.

The tests with the single strand of 7/18 antenna wire included observa-

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Adapters
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Condensers, variable
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Radio Essentials

Write for Complete Catalog P-9

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Your dealer will be glad to show you the Pacent Radio Essentials that you need for the next set you build.

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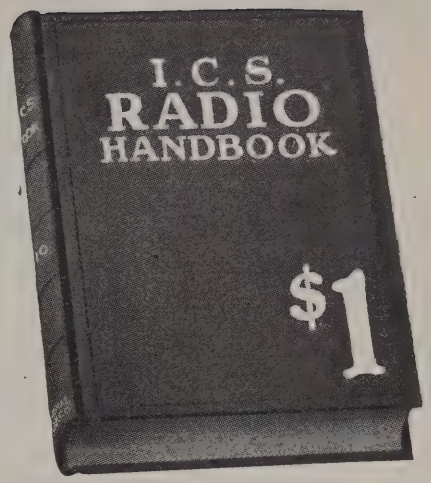

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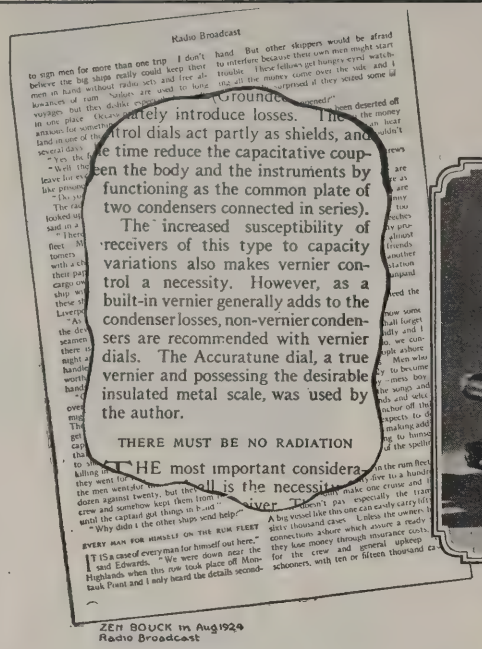

Radio Broadcast

...Grounded Antenna"...

...ately introduce losses. The ...trol dials act partly as shields, and ...e time reduce the capacitative coup... ...en the body and the instruments by functioning as the common plate of two condensers connected in series).

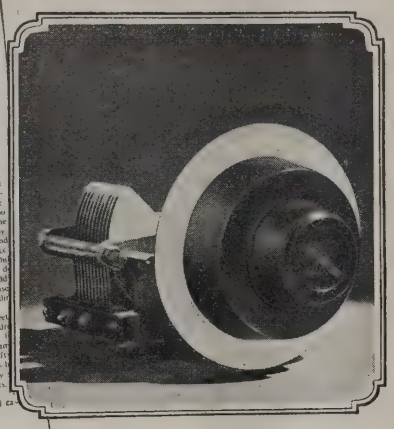
The increased susceptibility of receivers of this type to capacity variations also makes vernier control a necessity. However, as a built-in vernier generally adds to the condenser losses, non-vernier condensers are recommended with vernier dials. The Accuratune dial, a true vernier and possessing the desirable insulated metal scale, was used by the author.

THERE MUST BE NO RADIATION

THE most important considera... ...all is the necessity ...

ZEN BOUCK in Aug 1924 Radio Broadcast

Geared 80-1



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Radio Broadcast Laboratories, employing the most skilled licensed radio experts, use Accuratune Dials on the Broadcast "Knock Out" in preference to built in verniers. No stronger recommendation could possibly be accorded Accuratune Dials.

Accuratunes are actual micrometer dial controls designed for infinite tuning precision. Ten times more efficient than any condenser vernier attachment. Flush panel mounting. Fit all standard condenser shafts. Geared 80 to 1 ratio for accuracy and ease of operation.

Just try one! No description could possibly convey the genuine tuning satisfaction you receive, for this $3.50 instrument.

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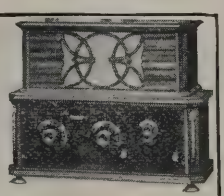

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MARSHALL RADIO PRODUCTS., Inc., Dept. 58-86
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tions with both inverted "L" and "T" type of electric radiating systems. It was revealed that more than one-kilowatt of electric energy could be "pumped" into this single strand antenna in the absence of excessive sparking, although the results of these experiments would seem to indicate that this type of antenna would be precluded on vessels equipped with 2-kilowatt transmitting sets. However, it is entirely feasible to use a one-kilowatt transmitter, operating on wave lengths not exceeding 800 meters, with the single 7/18 wire antenna.

Radio amateurs who are contemplating the abandonment of the multiple wire antenna for the one-wire radiating system will doubtless take into consideration the results of these trail-blazing experiments.

The one-fourth inch of bronze cable and the three-eighths inch steel rope exercised a tendency of sparking when more than one and one-half kilowatts of electric energy were impressed on this type of antenna. Of the single wire designs, full power could not be applied to any of these save the antenna composed of four strands of 7/18 antenna wire. Despite the fact that the physical dimensions of the one-fourth inch bronze cable are strikingly similar to the four twisted strands of antenna wire, the conductivity of the former is considerably less.

Broadcasting Answers

MR. GEORGE W. STIMPSON, Query Editor of The Pathfinder Magazine, has broadcast from WRC many of the answers to questions which come in to him.

The following are a fair sample.

Q. What are eyebrows for?

A. Men were given eyebrows to keep the sweat out of their eyes. They were given to women in the interests of exterior decoration.

Q. Why doesn't the stomach digest itself?

A. For the same reason that whisky doesn't make the bottle drunk. The truth is, the walls of the stomach are indigestible, just like a lot of food we get nowadays.

Q. How would the age of a person born on February 29 be computed?

A. In the first place, a person is a fool to be born on that day. Such a person becomes a year older each year just like anybody else; yet he has a real, honest-to-goodness birthday only every fourth year.

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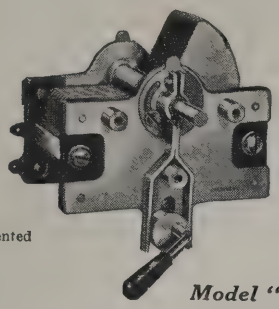

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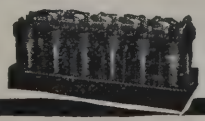

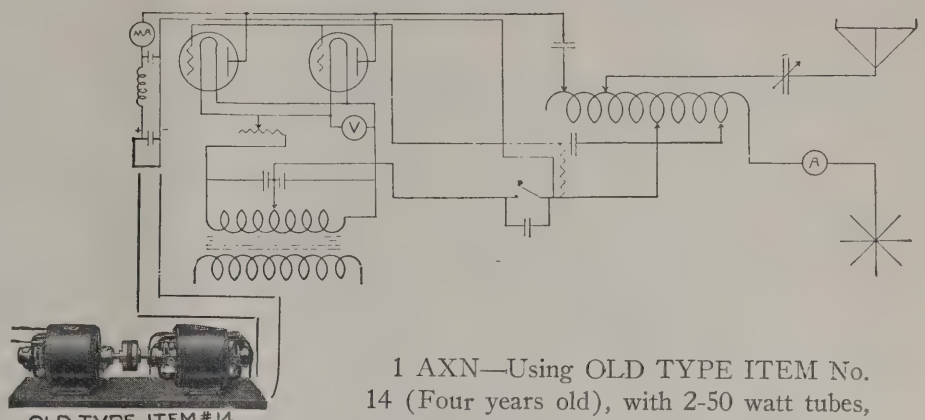

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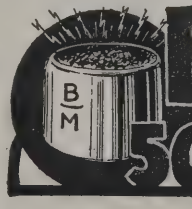

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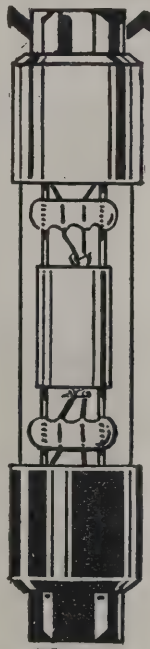

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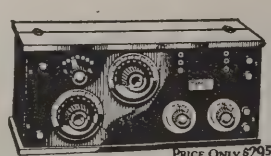

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AGENTS

THE MIDWEST RADIO COMPANY

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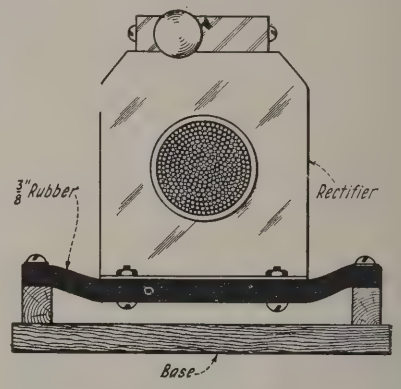
Q. Who was it that killed one-fourth of the people in the world and died before his father was born?

A. This gentleman must have been Cain. When he and his father and mother and brother were the only people in the world, he up and killed his brother, one-fourth of the people of the world. Cain's father, Adam, was not born, but created, therefore Cain died before his father was born.

And so it goes. The BCLs have responded to the spirit of this feature with hundreds of queries.

Noiseless Mounting for Mechanical Rectifier

ONE of the worst features of mechanical rectifiers is the terrific clattering clamor they manage to make while busily engaged in charging the "A" battery. Indeed, so great is the



noise that most fans put their mechanical rectifier in the cellar, others muffle them up in boxes; while some, we are afraid, throw the noise-makers away and buy a "quiet" type.

At the present time we belong to the latter class, but once we did have a vibrator "wrecktifier"—only it was fixed up so that it could scarcely be heard in operation.

This was accomplished through use of a rubber suspension mounting as shown in the accompanying end view sketch.

Here the base was the bottom of a dustproof and almost airtight cabinet; the rectifier was suspended at both ends with 3/8 inch rubber strip in the manner shown. Connections to the charger were made with flexible leads and a change-over switch, fuse and meter were mounted on the front panel of the cabinet. Rubber cushions were placed under the cabinet and, with the cover closed, the double rubber suspension together with the muffling effect of the cabinet served to minimize the noise.

SEPT. 1924 25 CENTS

Wireless Age

The Radio Magazine

Features in this Issue

Educational Extension by Radio

The Second Shot? By Garret Smith

"Build the Double Regenerative Receiver"

From Herdsboy to Scientific Heights

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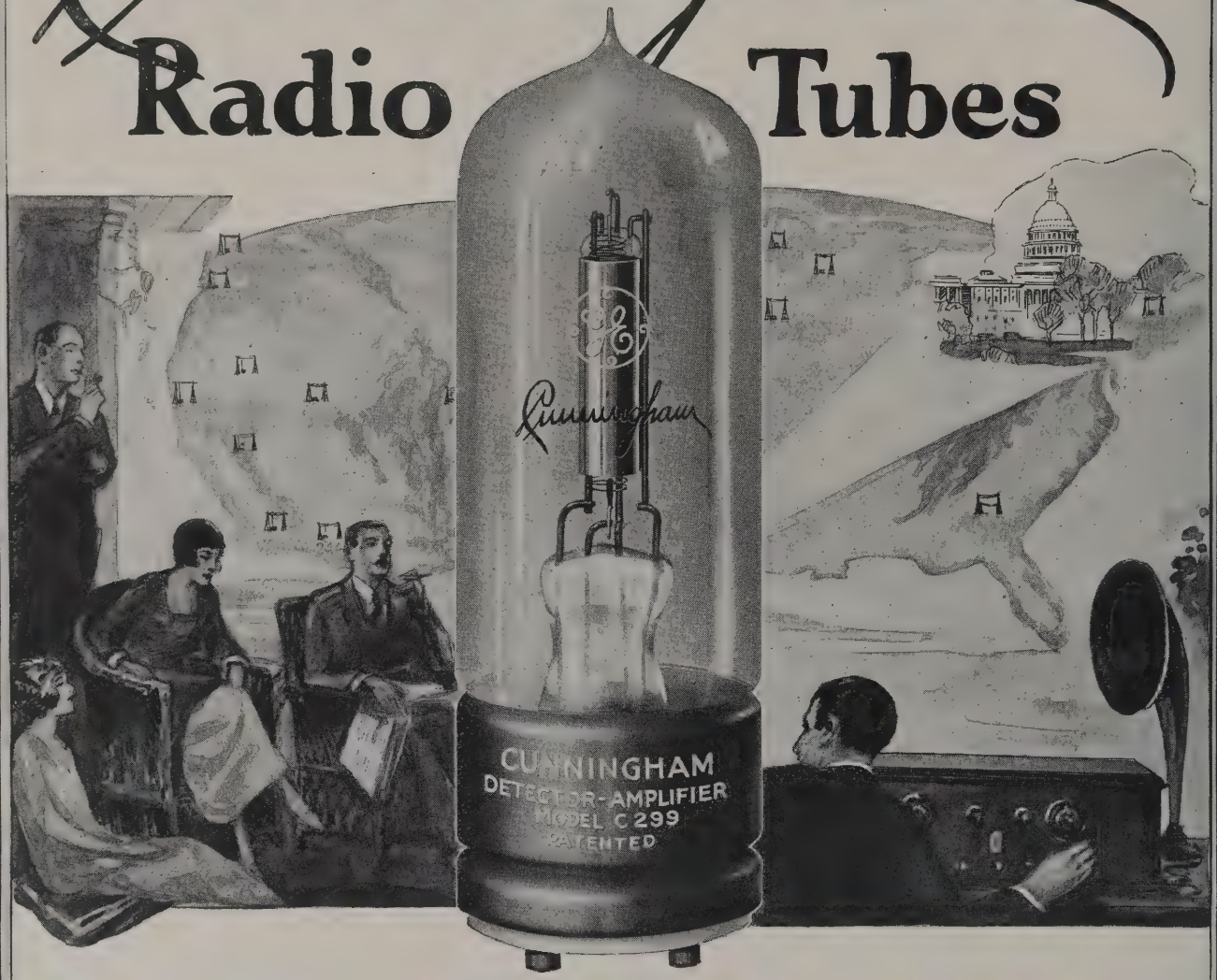
Cunningham Radio Tubes



Millions will listen-in on the broadcasting of the Presidential Campaign

This year, for the first time in history, it is possible for millions of United States citizens to hear every word of our statesmen in their oratorical battles for the honor of the presidential nominations and elections.

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The Wireless Age

America's Foremost Radiophone Review

Vol. XI — No. 12.

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Your Authors

GARRET SMITH (The Second Shot?) though still a young man has had considerable success in writing for the higher class magazines. Perhaps his best story is "Honest Hutch", a Saturday Evening Post story afterwards picturized by Will Rogers, and considered to be the best screen production ever turned out by that famous comedian. Mr. Smith has been associated with the New York Tribune for a long period. His best known long story is doubtless "On the Eve of 2000", published by The Frank A. Munsey Company.

ALFRED J. 'Hollywood' McCOSKER (Selling the Movies by Radio) has been in the newspaper field for seventeen years. He began as office boy under Arthur Brisbane, ran copy for Alan Dale of the N. Y. American and later did reporting on the Hearst newspapers throughout the country. While on the Boston American he inaugurated the annual movement: "Paint Up and Clean Up". Has been active on Western newspapers especially in Chicago, Denver and Salt Lake City. His work in the moving picture industry includes such positions as Editor of the Exhibitors Trade Review and Business Manager of the Motion Picture Department of the Morning Telegraph which was the pioneer newspaper motion picture department. His work in radio broadcasting movie information, particularly the features of the well known successes has earned him an enviable reputation.

STEFFEN F. NIELSSEN (The Yacht Ara's Complete Radio Outfit) is a world war veteran. His first schooling in radio was under the able direction of Poulsen — inventor of the Poulsen Arc Transmitter. Later he attended one of the prominent universities in Germany. Before the war he conducted the research work in the laboratories of the University of Texas. His knowledge of several languages and his extensive experience in both the theory and practice of wire and radio telegraphy and telephony, eminently fit him to speak authoritatively on matters of technical interest.

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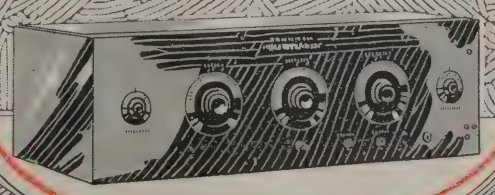

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by A. J. Haynes

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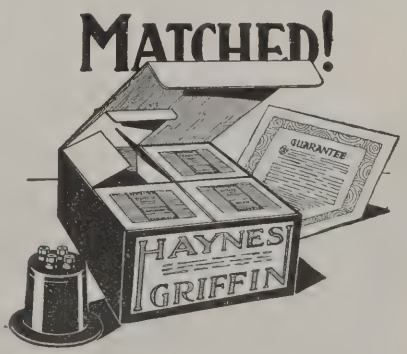

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The Super-Unidyne, although designed for antenna and ground, is unique in the ease of its selectivity. From three to five 360 meter stations may be heard in one evening, while still others are broadcasting on the same frequency. In our locality Los Angeles, California and Philadelphia—both on the same wavelength—have been tuned in the same evening without interference, while powerful stations 6 miles away were operating! WOAW on 526 meters and WOO on 509 meters have been easily tuned in, completely eliminating a 517 meter station three miles away. If more convenient ground only may be used as antenna with higher efficiency than a loop set.

Four dials are required for tuning, which tune together and log perfectly providing the convenience of enabling stations to be readily tuned in without interference when desired. No hunting for concerts if you have a log book. Tuned Radio Frequency Amplification plus oscillator action give all signals additional strength, regardless of distance. One stage Intermediate Amplification assures full volume and a clear, pure tone without distortion.

Uniradio small diameter air core transformers and tuned R. F. Transformers have made the Super-Unidyne possible. Kits, priced at $16.00, designed exclusively for the experimenter, together with blue print, make it possible for everyone to build their own set. Blue print only, showing wiring diagram and details of construction—$1.50.

Uniradio Transformers and Parts mean a decided improvement in Super-Heterodyne sets. Complete kits for any type super may be purchased at prices ranging from $7.50 to $20.00.

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If your Dealer does not carry UNIRADIO Parts we will supply you direct. Jobbers and Distributors will want our line. Write or wire for proposition.

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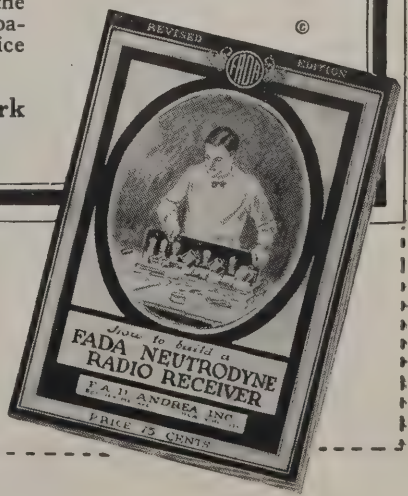

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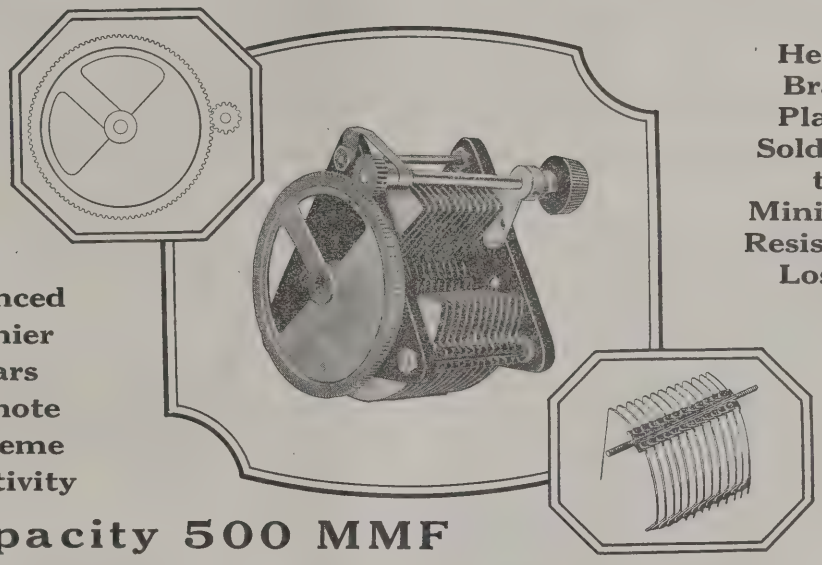

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Rich brown burled walnut, with door-panel borders of inlaid ebony and holly —5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35½" long—16⅝" deep—42½" high.

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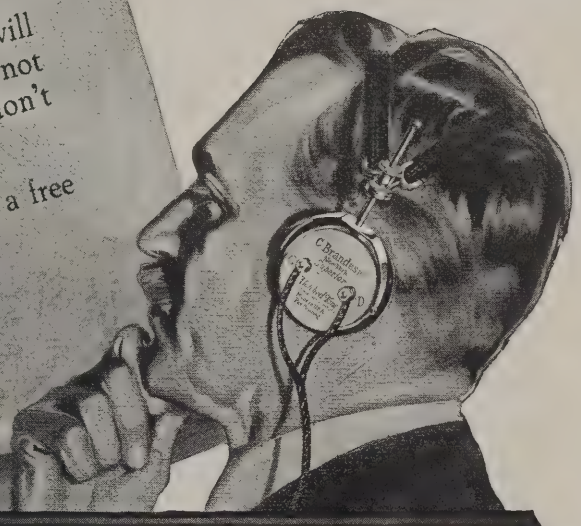

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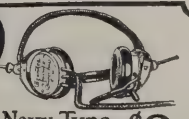

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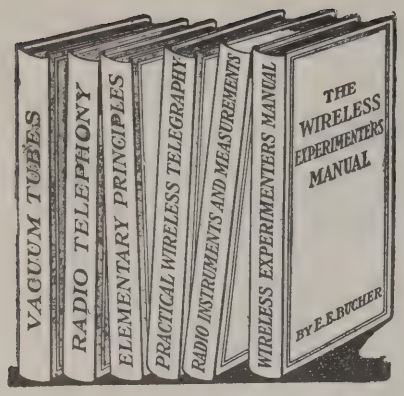

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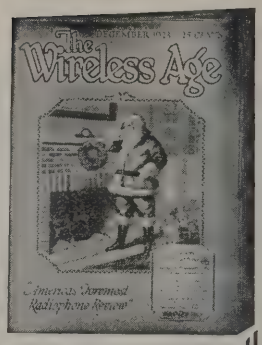

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Alexanderson System	E. E. Bucher	1.25	18
Practical Amateur Stations	J. A. White	.75	10
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The Oscillation Valve	Bangay	2.75	40
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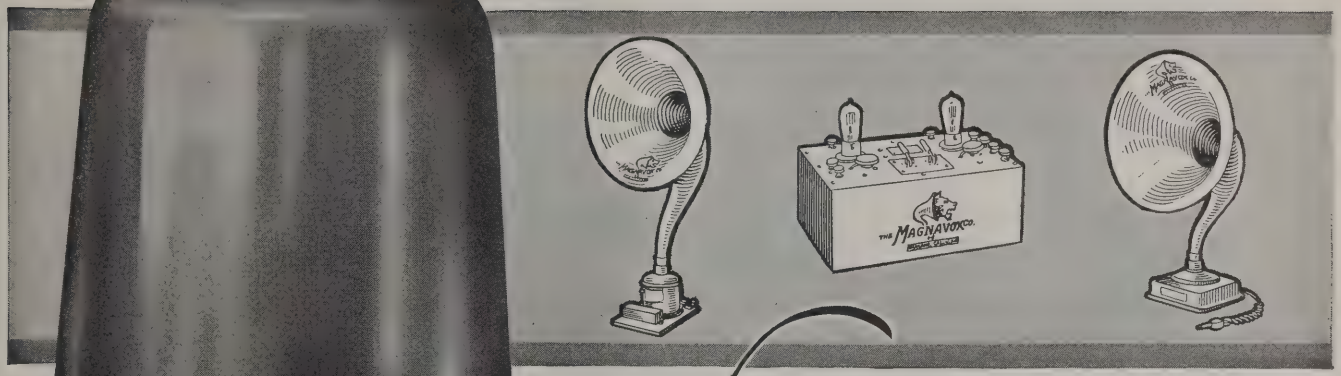
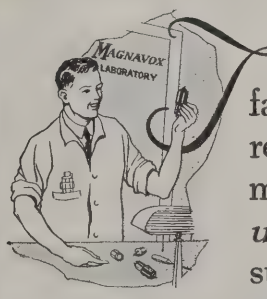


Now a MAGNAVOX Tube



THE engineers who developed the famous Magnavox line of radio reproducing and amplifying equipment have now produced a *vacuum tube* equally distinctive and successful in its own field.

One trial convinces the most exacting user that the Magnavox will replace ordinary tubes to great advantage in any receiving set.

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Reproducers of electro-dynamic and semi-dynamic type, for all vacuum tube receiving sets; $25.00 to $50.00

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Vacuum Tubes: A storage battery tube of new and approved design for all standard circuits . . . $5.00

Magnavox Radio Products are sold by reliable dealers everywhere. If unacquainted with the Magnavox store in your vicinity, write us for information.

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MAGNAVOX RADIO VACUUM TUBE TYPE A is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Highly recommended also for detector use. This tube is not critical of adjustment either as to plate or filament. Filament consumption one quarter of an ampere.

The most notable feature of the new Magnavox Radio Tube consists in eliminating the grid.

Unlike the ordinary storage battery tube, Magnavox Tubes give the electrons an unobstructed passage between filament and plate, with the result that the Magnavox has less than one half the internal capacity of other tubes of similar type.

9R

Editorial Chat

THIS is the month of school-days and the return to pursuits of study and learning. Quite appropriately, therefore, THE WIRELESS AGE presents a comprehensive story of the past, present and future systems of education. Never before in the world's history could it be said, "a twirl of the dial brings to us the wisdom of the ages," but radio in our day has made it literally true, and in addition, the system of education now in vogue—radio broadcasting—returns us to the natural channels of acquiring knowledge—truly can it be said: "In the school of learning it is once again playtime—we play while we learn."

PROF. M. I. PUPIN

Truth is stranger than fiction 'tis said. Read the story of Professor M. I. Pupin in this issue and draw your own conclusions. No tale of fiction could be more fascinating or inspiring than the true life story of the Serbian herdsboy who roamed westward across the sea to the land of opportunity, and with unrelenting zeal embarked on a course of learning that brought him to the scientific heights. Read the story of his achievements. It will inspire and instruct.

THE SECOND SHOT?

Garret Smith has done a radio fiction story that should prove entertaining. Everybody enjoys a mystery, and while some think there is considerable mystery about radio, when another mystery is added to it, an appeal is made to our inquisitiveness that demands appeasing. Such is the plot and character of "The Second Shot?" You will like it. There are other stories coming.

CHILD EDUCATION

Mothers particularly will derive help and enjoyment by reading Mrs. Christine Frederick's article on "Radio and Family Education."

The practical application of radio broadcasting in the home for the purpose of instruction and culture of the child mind and also the grown-ups, as well as a means of relieving mother of some of her numerous responsibilities is told in the language of experience. Mrs. Frederick relates what she has actually accomplished in this direction.

TECHNICAL

The Double Regenerative Receiver, another construction article that will arouse interest, is presented to our "fans." It is up-to-the-minute. Tried and tested in our own laboratory, we acclaim it unusual for volume with UV-199's, and selectivity is all that can be desired.

Then there is the article about the yacht *Ara's* radio installation. This will appeal to the experienced.

TRAVEL

"The Adventures of a Radio Operator" will take you abroad—so to speak—on travels through the Orient where you will find many strange things in out-of-the-way corners.

VARIETY

This issue of your magazine is another you will enjoy. Then open your mind to the pleasure of still another to come. Information with a punch—entertainment that is informative—in short, what you want, as you like it, wh t ought to be. WIRELESS AGE—THE Radio Magazine.

— EDITORS.

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Clarity
Beauty
Volume
Distance
Selectivity

A 5-TUBE SET

built of the finest low loss material and in a beautiful genuine solid mahogany cabinet at only *sixty dollars.*

Ask your dealer for a free demonstration
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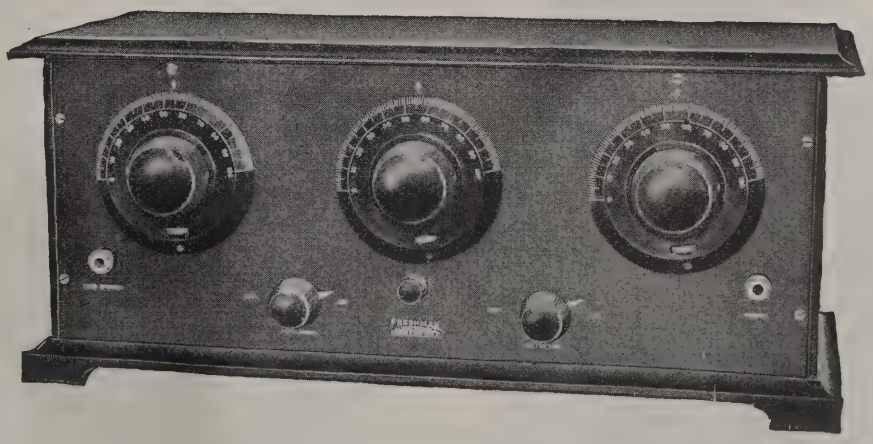
Noneutralizing or balancing condensers to fuss with.

Self Balanced —Low-Loss.

A Tuned Radio Frequency Receiver

that will bring even the most distant stations to your home with surprising clarity and volume. So selective that you can pick up any station you want — night after night—at the same dial settings, and, what's more, it is the easiest set in the world to operate.



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Watch Your Batteries—

Test them often: run-down and poor batteries cause 60% of all radio trouble.

¶ Don't guess or putter—make sure. The Jewell No. 84 is a high grade, sturdy and accurate miniature "B" Battery Voltmeter (0 to 150 volts).

¶ Every dealer should use a Jewell No. 57 double reading Voltmeter to test both "A" and "B" batteries before they sell them. Many set owners also use this instrument.

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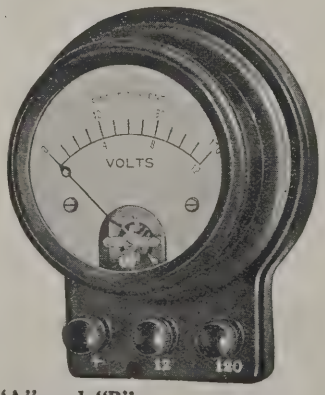

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IF you could make a comparison *capacity test* of our noiseless mica condensers,—as many leading set manufacturers have done,—you likewise would ever after insist on

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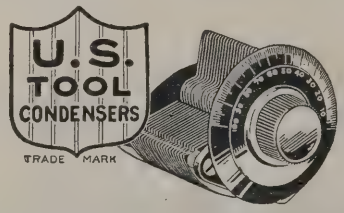

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One Piece Stator, Hexagon Shaft—eliminating fanning of rotor blades; Three Mounting Lugs and Pigtail Connection.

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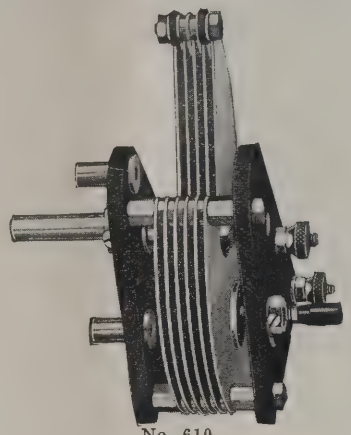
Radio fans, who have had trouble connecting and adjusting grid biasing condensers, will appreciate our new condenser code 610, which the Kellogg Company have just placed on the market. This is a standard 11 plate variable condenser of minimum .000074 and maximum .00035 microfarad, and it has as part of the construction, a micrometer vernier condenser with a capacity minimum of one micro-microfarad and a maximum of ten micro-microfarads.

The use of these condensers in any stage improves not only the appearance of the set, because of reducing the amount of wiring and apparatus, but actually aids in more efficient tuning.

Ask your dealer to show you a complete line of Kellogg Radio Equipment.



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Use Is the Test

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Madison, Wisconsin

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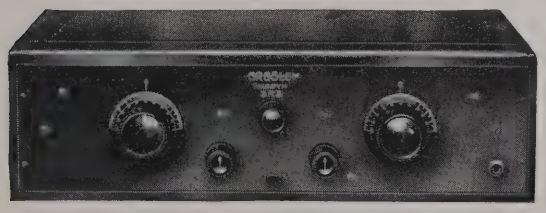
Before you purchase a radio receiver listen in on a Crosley Trirdyn.

For Sale by Good Dealers Everywhere.



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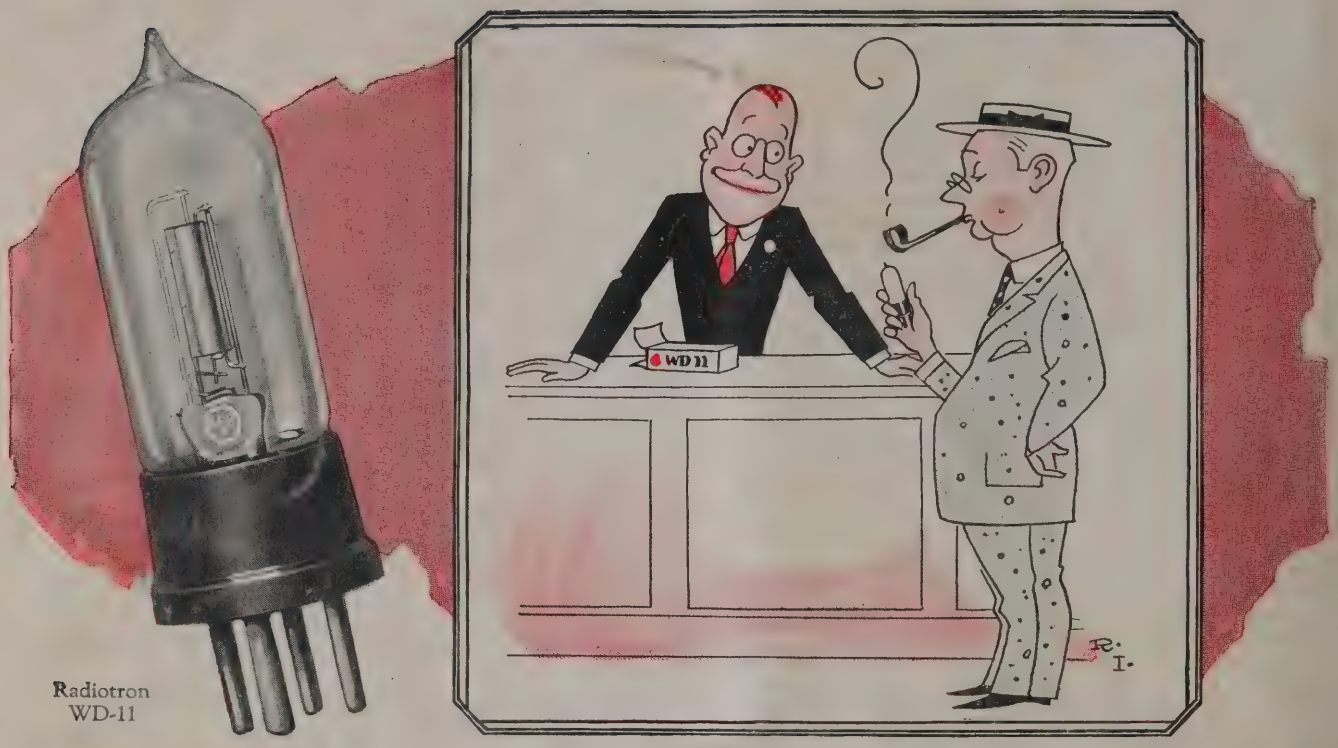

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WD-11

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It isn't a genuine WD-12 unless it's a Radiotron.
It isn't a genuine UV-199 unless it's a Radiotron.
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